

FLOODS AND LEVEES

OF THE

MISSISSIPPI RIVER

BY

BENJAMIN G. HUMPHREYS

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“Shall it lie unproductive in the public vaults? Shall the revenue be reduced? Or shall it not rather be appropriated to the improvements of roads, canals, rivers, education, and other great foundations of prosperity and union under the powers which Congress may already possess or such amendment of the Constitution as may be approved by the State.”

—*Thos. Jefferson*

To My Colleagues of the Sixty-third Congress:

Before many weeks there will probably come before the House a proposition to commit the Federal Government to the speedy completion of the levee system on the Mississippi River.

I have undertaken to collate such data, and set out in orderly sequence such related incidents as are thought necessary to a proper understanding of the problem to be solved. The platforms of all three of the great political parties in 1912, distinctly, specifically and emphatically declared that the control of the floods of the Mississippi River was a national problem, and the Democratic party went so far as to declare that "this problem imposes an obligation which alone can be discharged by the General Government." In accepting the nomination of the Baltimore Convention, Mr. Wilson said: "In the case of the Mississippi River, that great central artery of our trade, it is plain that the Federal Government must build and maintain the levees and keep the great waters in harness for the general use."

I fully understand that while pre-election pledges must be kept and platform promises carried out, it is, nevertheless, incumbent upon the proponents of any measure to show not only that party platforms and party candidates are pledged to its enactment, but also to present the arguments, the reasons, and the facts which justify these promises and declarations. I shall, therefore, endeavor to demonstrate that the levee system is the only means by which these floods can be controlled; that the riparian owners should not be called upon to contribute towards their construction more than is contemplated in the legislation proposed; that they could not do more if required; that Congress has ample and full power under the constitution to warrant the appropriation; and that the benefits which would accrue to all the people from this legislation are so great, and the contribution to the aggregate wealth of the country so enormous, as to constitute a truly national problem.

B. G. HUMPHREYS

Washington,
January 26, 1914.

THE PROPOSED LEGISLATION.

The project which is now pending before the House is in no sense a new one. It was in fact adopted by Congress March 3, 1881, and provided for the improvement of the Mississippi River "in such manner as will improve and give ease and safety to the navigation thereof, prevent destructive floods, promote and facilitate commerce, trade and the postal service." The proposition, therefore, is not to adopt a new project, but simply to provide sufficient funds to complete a project which was adopted thirty-three years ago. The Mississippi River Commission have reported that the cost of a completed levee system sufficient in grade and section to withstand the largest floods, will cost for the river below Cape Girardeau \$57,000,000, and for the river above Cape Girardeau \$6,000,000. Heretofore the levees have been constructed by the local levee boards and the Mississippi River Commission working harmoniously along identical lines. The local interests have contributed something more than \$70,000,000 for the work and Congress has provided \$30,000,000. The legislation which is now being advocated proposes that the Federal Government shall contribute \$45,000,000 and the local interests make up the difference. Heretofore no requirement for local contribution has been carried in any legislation of Congress, the \$70,000,000 above referred to having been provided by the localities upon their own motion. It is provided in this legislation, now pending, that there shall be local contribution, at least to the extent of one-third of the amount expended by the Commission. It is not contended by any one that the project which was adopted in 1881, and which has been continuously carried on since that date, should be abandoned. The insistence, however, of the proponents of the pending legislation is that every consideration of economy requires that the project be completed expeditiously; and to this end it is proposed that Congress appropriate \$9,000,000 a year for the construction of levees for the next five years, during which time local interests shall contribute an additional fund sufficient to complete the levee system. The estimate of \$57,000,000 for the lower Mississippi does not take into account the rebuilding of levees

that may be breached or washed away by floods in the future. If the appropriations are continued on so small a scale as heretofore and the completion of this work thereby extended over another thirty years, it is certain that other floods in the future, as they have done in the past, will destroy much of the work already and hereafter done, thereby making the ultimate cost of a complete system very much greater. Only once in the history of the river have the levees withstood the floods for a period as long as nine years, which was from 1903 to 1912. Since then three floods have come down the river, each one breaking the levees and doing great damage.

The expenditures made in a campaign to prevent the uncompleted levees from being destroyed is naturally the most costly work done. The following letter from the Assistant Chief Engineer of the Lower Yazoo Levee District explains this fully:

BOARD OF
MISSISSIPPI LEVEE COMMISSIONERS
ENGINEER'S DEPARTMENT

W. L. Thompson, Chief Engineer
Robt. Somerville, Ass't Chief Engineer

GREENVILLE, MISSISSIPPI, *January 9, 1914.*

Hon. B. G. Humphreys,
House of Representatives,
Washington, D. C.

My dear Mr. Humphreys:

Senator Percy has sent me your letter of December 31st asking for some information relative to high water expenses of past years. The expenses for high water protection by this Board since 1882, including that year, are as follows:

1882	\$59,212.75
1883	19,628.96
1884	30,921.11
1890	134,107.50
1891	41,668.46
1892	35,817.92
1893	14,759.22
1897	96,170.39

1898	96,464.96
1903	122,201.32
1907	32,541.95
1912	181,005.34
1913	232,070.72

I have omitted years when the expenses were small. In addition to these amounts expended by the Levee Board, the Government has expended some monies in most, or all, of these years for high water protection in this levee district, but I cannot ascertain the exact amount, as they are merged with engineering expenses in their report.

As you well know, the greater part of the money expended during high water is entirely lost. I think it a very low estimate to say that at least 95% is entirely wasted. The reasons for this are that the Levee Board forces are not organized for high water, consequently we have to take on a great many inexperienced men who do injudicious work. But by far the greatest reason for the loss is in consequence of the base of the levee and surrounding ground being so saturated with water that we cannot use scrapers, or other means ordinarily employed for handling dirt. The earth has to be handled in sacks, and the cost of the sacks alone to place a yard of dirt is between 60 and 70c, this being three to four times as much as the placing of a yard of dirt would be during low water time. Then of course owing to the ground and levee being wet the labor handling the sacks costs three or four times as much. And then too a great deal of the material that is put in the levees during the high water, being underlaid with brush and mixed with sacks, which decay, has to be removed after the water goes down. So that an additional cost is thereby caused.

Yours very truly,

ROBT. SOMERVILLE,
Asst. Chief Engineer.

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Since 1882 this one levee district, which has a levee line of only 190 miles in length, has expended in emergency campaigns of the character above mentioned the enormous sum of \$1,098,570.60! In the River and Harbor bill of 1912 Congress appropriated \$4,000,000 for levee construction, \$2,000,000 of which was expended in repairing broken and destroyed levees, and later on in the same

session the Sundry Civil appropriation bill carried an item of something more than \$1,000,000 to defray the expenses of the War Department incurred in relief work among flood sufferers. Repetitions of this experience are inevitable unless Congress views the situation in a business-like way and provides for the completion of this project within a reasonable limit of time. It is also proposed that the Secretary of War be authorized to make continuing contracts for the completion of the work. This authorization is necessary if the work is to be done economically. If contractors can be given assurance of several years' work many more bidders will appear, and the price bid for work will therefore be much less. They cannot afford to invest in the necessary plant and equipment unless they can be assured of work for a series of years, and the few who do undertake the work under limitations of annual appropriations, do, and necessarily must charge more for the work to be done. On the other hand if appropriations are authorized for, say four years, the Commission itself can then afford to purchase the necessary plant and equipment to do the work by day labor and the bare fact of this advantageous possibility is a potent influence in reducing the bids of contractors. This has been the experience in River and Harbor work in all parts of the country. Only a few days ago Col. Black, of the Engineer Corps, referring to work on the New York Harbor, stated:

"The Chairman. If we were to undertake to do this in five or six years and you were given a sufficient amount of cash and sufficient authority to make continuing contracts about what do you think would be the saving to the government in that work?

Col. Black. I have put my estimate at as low a figure as possible. If I can make large contracts I would be able to save at least one-fourth.

The Chairman. And you would have the work completed in five or six years instead of having it completed in 27 years?

Col. Black. Yes sir, it would be a great deal better for New York if Congress found that the income was not big enough to stand a large appropriation annually to give us a large appropriation every two years and then give us two small appropriations.

The Chairman. That is an argument that can be made with regard to almost any project.

Col. Black. Yes, sir, except where the government owns its own plant, and then all it wants is operating expenses.

Mr. Humphreys. Assuming that that would hold true everywhere, which I very greatly doubt, and assuming that that is an accurate statement, if we were to expend \$40,000,000 a year we would just be wasting ten million.

Col. Black. I think that is a conservative estimate."

In several instances, Congress has included in the act authorizing the improvement authority for the Chief of Engineers, in his discretion, to spend a part of the funds provided in the construction of a dredge, in the event no satisfactory bid could be obtained from private contractors; and in one or two notable instances the price per cubic yard of excavation has been reduced by the bidding contractors so much below the price at which they had formerly offered to do the work as to render the construction of the dredge inadvisable. The local levee boards, which are to be our allies in this work, if other destructive floods come on them before the levees are completed will necessarily be impoverished to such an extent as to make it impossible for them to raise the amount required of them under the provisions of the proposed legislation.

From the above statement it will be observed that Congress is not being asked to embark upon any new sea of Federal endeavor or expenditure, but simply to complete the work already begun in the interest of all concerned.

Many plans have been suggested for the prevention of floods on the Lower Mississippi—Outlets, Reservoirs, Cut-offs, Diversion of Tributaries, and Levees. All of these plans have been investigated thoroughly by the engineers corps of the Army and all have been discarded as inapplicable with the exception of the levee system, which has been recommended as the proper method. Many commissions have been appointed by Congress to investigate the subject—Bernard & Totten, in 1822; Chas. Ellet, Jr., in 1852; Humphreys & Abbott, in 1861; the Warren Commission in 1875; the Nelson Committee in 1898. In addition to these the Mississippi River Commission was created in 1879 and has continuously since then studied the question, and their annual reports fill many vol-

umes. All of these commissions investigating the various methods proposed have agreed that the best method for flood control is the levee system. After the floods of 1913 President Wilson requested the Mississippi River Commission to make a further report, and in compliance therewith Col. C. McD. Townsend, President of the Commission, on the 16th of May, 1913, submitted the following, which is the last report on the subject:

MISSISSIPPI RIVER COMMISSION,

OFFICE OF THE PRESIDENT,

St. Louis, Mo., May 16, 1913.

From: The president, Mississippi River Commission.

To: The Chief of Engineers, United States Army.

Subject: Mississippi River floods.

1. In compliance with instructions contained in your letter of April 29, 1913, and on behalf of the Mississippi River Commission, I submit the following report upon:

(a) How best to prevent the occurrence of destructive floods in the Mississippi River Basin.

(b) How to prevent or reduce to a minimum the damages which might be caused by such floods.

2. Many of the questions involved have been discussed in great detail by the commission in its annual reports, but in accordance with your verbal directions this report is made as brief and concise as practicable, and there are appended two papers I have recently prepared and which, in general, accord with the views of the commission. Reference is made to these appendices for a more extended discussion of the subject matter.

3. The floods of the Mississippi River Basin are caused by heavy storms originating in the Gulf of Mexico. Like cyclones, earthquakes, and volcanic eruptions, they are acts of God, which man can not prevent; and the rainfall during these storms is so excessive that the works of man have little effect in increasing or diminishing the volume of the flow resulting therefrom. (See Appendix B, p. 20.)

4. Numerous methods to prevent or reduce to a minimum the damages caused by such floods have been suggested:

(1) *Reforestation*.—While forests may have some influence on a river during midstages they produce little effect either during extreme floods or extreme low water. It takes too long a time for trees to grow and the humus to form under them for reforestation to be a practical solution

of flood prevention in the Mississippi Basin. It would also require the abandonment of too much land needed for agricultural purposes. (See Appendix B, p. 21, and Appendix A, p. 8.)

(2) *Reservoirs*.—In a mountainous country, where short, high dams can create reservoirs of great depth and volume, or in a comparatively level country where low dams can form lakes of large area, it may be practicable to control floods by means of reservoirs. There is but a comparatively small section of the Mississippi Basin that fulfills either of these conditions, and in such areas the rainfall is generally light. The rolling country, which forms the greater part of the Mississippi Valley and from which the water that produces its floods is derived, can be protected from floods by reservoirs only by an enormous expenditure. (See Appendix B, p. 23, and Appendix A, p. 9.)

(3) *Cut-offs*.—By cutting off the bends in a river, its length is diminished and slope increased. This would increase its discharge at a given height. This method of relief can not be applied to the Mississippi River, as it would seriously injure its navigability during low water, and increase the caving of its banks which is now excessive. While it would afford relief in the upper portions of the section of the river thus straightened, it would increase flood heights at the lower end, benefiting one locality at the expense of another. (See Appendix A, p. 11.)

(4) *Outlets*.—Outlets, while locally reducing flood heights, have only limited application as a means of relief from Mississippi floods. They can not be constructed above the mouth of Red River; their influence on flood heights extends only comparatively short distances above the locality where they are constructed; there is a tendency for the river to diminish its area of cross section below them; they have to be protected by levees of the same dimensions as the river itself; and there is danger, if the outlet is made sufficiently large to be of practical value, that the river may abandon its present channel and adopt that of the outlet. (See Appendix A, p. 11. The subject is further discussed in Annual Reports of the Mississippi River Commission for 1881, 1882, 1884, 1885, 1890-91, 1893, and 1912.)

(5) *Diversion of flood waters into channels parallel to the main river*.—The maximum flood discharge of the Mississippi River exceeds 2,000,000 second-feet, while it discharges about 1,000,000 second-feet at a bank-full stage.

A side channel which would discharge the excess flood waters would therefore require an area of cross section equal to that of the river itself at bank-full stage, and with the same characteristics as to depth and velocity.

(6) *Levees*.—Levees afford the only practicable means of preventing the damages which might be caused by floods in the lower Mississippi Valley. They have been successfully employed on European rivers, and are the only means of flood protection of large rivers that have been tested, or, if tested, have not failed. To restrain floods like those of 1912 and 1913, will require in the existing levee line about twice the yardage now in place. The estimated cost of such an enlargement is \$57,000,000. (See Appendix A, p. 13; Appendix B, pp. 25 and 27.) Levee construction has not raised the bed of the Mississippi River. (See Appendix A, p. 12, and Appendix B, p. 26.)

(7) Floods have not increased either in volume or frequency in recent years. (See Appendix B, p. 25.)

C. McD. TOWNSEND,
Colonel, Corps of Engineers.

ENDORSED BY STATESMEN FROM JEFFERSON TO
WILSON, FROM HENRY CLAY TO BRYAN!

There is nothing new in the contention that this is a great national question. In returning, without his approval, the omnibus Rivers & Harbors bill, President Tyler in his message of June 11, 1844, said:

"In sanctioning a bill of the same title with that returned, for the improvement of the Mississippi and its chief tributaries and certain harbors on the Lakes, if I bring myself apparently in conflict with any of the principles herein asserted it will arise on my part exclusively from the want of a just appreciation of localities. The Mississippi occupies a footing altogether different from the rivers and water courses of the different States. No one State or any number of States can exercise any other jurisdiction over it than for the punishment of crimes and the service of civil process. It belongs to no particular State or States, but of common right, by express reservation, to all the States. It is reserved as a great common highway for the commerce of the whole country. To have conceded to Louisiana, or to any other State admitted as a new State to the Union, the exclusive jurisdiction, and consequently the right to make improvements and to levy tolls on the segments of the river embraced within its territorial limits, would have been to have disappointed the chief object in the purchase of Louisiana, which was to secure the free use of the Mississippi to all the people of the United States. Whether levies on commerce were made by a foreign or domestic government would have been equally burdensome and objectionable. The United States, therefore, is charged with its improvement for the benefit of all, and the appropriation of governmental means to its improvement becomes indispensably necessary for the good of all."

In a letter to the Chicago Convention in 1847 Thos. H. Benton, one of the choice and master spirits of the age, thus apostrophized the Father of Waters:

"Wonderful river! connecting with seas by the head and by the mouth—stretching its arms towards the Atlantic

and the Pacific—lying in a valley, which is a valley from the Gulf of Mexico to Hudson's Bay—drawing its first waters not from rugged mountains, but from a plateau of lakes in the center of the continent, and in communication with the sources of the St. Lawrence and the streams which take their course north to Hudson's Bay—draining the largest extent of richest land—collecting the products of every clime, even the frigid, to bear the whole to a genial market in the sunny south, and there to meet the products of the entire world: Such is the Mississippi! And who can calculate the aggregate of its advantages, and the magnitude of its future commercial results?"

It will be shown that when he submitted his report, in response to the resolutions of the Memphis Convention in 1845, Mr. Calhoun recommended to the Senate that an appropriation be made for the specific purpose of building embankments along the Mississippi River to protect the lands from overflow. The appropriation he recommended took the form of a donation of public land, but as these lands were to be sold and the proceeds of the sale devoted to this purpose instead of being covered into the treasury, the difference was one of procedure and not of principle.

Henry Clay, always the champion of the valley and all its interests, in an impassioned speech in the Senate, said:

"With regard to the appropriations made for that portion of the country from which I come, the great valley of the Mississippi, I will say that we are a persevering people, a feeling people and a contrasting people; and how long will it be before the people of this vast valley will rise en masse and tumble down your little hair-splitting distinctions about what is national, and demand what is just and fair on the part of this government in relation to their great interests? The Mississippi, with all its tributaries, constitute a part of a great system, and if the system be not national I should like to know one that is national. We are told that a little work, great in its value, one for which I shall vote with great pleasure, the breakwater in the little State of Delaware, is a great national work, while a work which has for its object the improvement of that vast system of rivers which constitute the valley of the Mississippi, which is to save millions and millions of property and many human lives, is not a work to be done because not national!"

Abraham Lincoln said:

"The driving of a pirate from the track of commerce in the broad ocean and the removing of a snag from its more narrow path in the Mississippi cannot, I think, be distinguished in principle. Each is done to save life and property, and to use the waterways for the purposes of promoting commerce. * * * The most general object I can think of would be the improvement of the Mississippi River and its tributaries."

Andrew Johnson, in a message to Congress specifically urged legislation for the preservation of the levees of the Mississippi River declaring it to be a matter of national importance. I quote his words:

"As a subject upon which depends an immense amount of the production and commerce of the country, I recommend to Congress such legislation as may be necessary for the preservation of the levees of the Mississippi River. It is a matter of national importance that early steps should be taken, not only to add to the efficiency of these barriers against destructive inundations, but for the removal of all obstructions to the free and safe navigation of that great channel of trade and commerce."

Garfield in his letter accepting the nomination for the Presidency declared:

"The wisdom of Congress should be invoked to devise some plan by which that great river shall cease to be a terror to those who dwell upon its banks, and by which its shipping may safely carry the industrial products of 25,000,000 of people."

Hayes not only recommended the legislation but also approved the bill creating the Mississippi River Commission and signed the first bill appropriating money for levee construction.

Arthur in a message to Congress said:

"The constitutionality of a law making appropriations in aid of these objects cannot be questioned. The safe and convenient navigation of the Mississippi is a matter of concern to all sections of the country; but to the Northwest, with its immense harvests, needing cheap transportation to the sea, and to the inhabitants of the river valley, whose lives and property depend upon the proper construction of the safeguards which protect them from the

floods, it is of vital importance that a well-matured and comprehensive plan for improvement should be put into operation with as little delay as possible."

And then recalling the fact that the heavy hand of the Federal tax gatherer had been laid upon these people at a time when they were least able to survive the blow, and when they were grappling in a death struggle with the great floods of the later 60's, added these significant words:

"It may not be inopportune to mention that this government has imposed and collected some \$70,000,000 by a tax on cotton in the production of which the population of the lower Mississippi is largely engaged, and it does not seem inequitable to return a portion of this tax to those who contributed it, particularly as such action will also result in an important gain to the country at large, and especially so to the great rich States of the Northwest and the Mississippi Valley."

Roosevelt said:

"We, the Nation, must build the levees and build them better and more scientifically than ever before."

Taft said:

"I am strongly in favor of expending the whole \$50,000,000 to save that part of the country from floods in a reasonable time, and to provide a proper levee system."

The following editorial from the *Commoner* of April 11, 1913, is quoted for obvious reasons. I am aware that editorial expressions, as a rule, do not carry that same weight which is attached to expressions from those who are charged with the responsibility of government, such as above quoted; but we cannot overlook the fact that the *Commoner* is edited by Mr. Bryan, who was three times nominated by the Democratic Party as its candidate for the presidency, and that at the time the following editorial was written he was Secretary of State in the Cabinet of Mr. Wilson. In view of these facts neither apology nor explanation is necessary for including this editorial along with the expressions which have been quoted from other great men in the past history of the country:

"For years the people of the lower Mississippi and those living at intersections of the Ohio and Mississippi

rivers have been subjected to losses and great inconveniences through floods. There has been considerable discussion and some effort in a small way to relieve these conditions. The recent floods will serve to direct attention to a duty the discharge of which has all too long been neglected. Engineers agree that the bad conditions referred to could be prevented through the application of laws with which engineers are familiar. The sections affected by these floods lie in the very heart of the United States and it goes without saying that extraordinary efforts ought to be made to protect these sections. The work of protection should be commenced in earnest and should be carried to successful conclusion even though it requires an enterprise on a scale so large as the Panama canal. A comprehensive engineering plan will provide the people living in the heart of America with protection from floods. This is the opinion of experienced engineers. The good work can not be commenced any too soon. Such an enterprise is in harmony with the pledge given by the democratic national convention for 1912.

Let this platform plank be faithfully carried out."

There can be no escape from the conclusion that this plank in the platform should "be faithfully carried out." It was written into the platform at a time when the conscience of the whole country had been aroused by the frightful destruction which had taken place in the lower valley by the flood of 1912. Congress had made large appropriations both for the reconstruction of the levees which had been destroyed as well as for relief work among the people of the valley who had been rendered homeless and destitute. It declared that the building of levees for the prevention of overflow of the land and its consequent devastation "imposes an obligation which alone can be discharged by the Federal Government." Recognizing the importance and the justice of this policy, Mr. Wilson, in his address accepting the nomination of the Baltimore Convention on this platform declared unequivocally that "in the case of the Mississippi River, that great central artery of our trade, it is plain that the Federal Government must build and maintain the levees and keep the great waters in harness for the general use. It is plain, too, that vast sums of money must be spent to develop new waterways where trade will be most served and transportation most readily cheapened by them. Such expenditures are no largess

on the part of the government; they are national investments."

It is now up to Congress to fulfill these pledges to the people and to add this great piece of constructive legislation as one of the gems which are to form the crowning glory of the legislative achievements of the sixty-third Congress.

HISTORY OF THE LEVEE SYSTEM.

The Levee or "dyke" system for the control of floods is not a new theory; in fact it is as old as recorded history. As early as the twelfth dynasty, the Pharaohs were building levees along the banks of the Nile for the purpose of preventing the overflow of its alluvial deltas.

Sir William Willcocks, late Director General of Reservoirs in Egypt, in a lecture delivered at a meeting of the Khedivial Geographical Society on the Assuan Reservoir in 1904, said:

"Of all the methods which Egypt has ever employed for the increase of her material wealth, there is only one which has never failed her. Whenever the country has turned to the Nile it has not been disappointed. It was so 4,000 years ago when the problems of water storage and flood control engaged the attention of the Pharaohs of the XIIth Dynasty. It is so today. The problem which the engineers of Amenemhat solved differ but little from the problems which we are called to solve today. In those ancient times the absence of masonry regulators made it more difficult to control floods than to provide additional water. For us the provision of additional water is more difficult than protection from floods. Both, however, are equally important.

There is a popular belief that the only function which the levees on the Nile perform is to conserve the flood waters for purposes of irrigation. This is a mistake. The great enemies of Egypt with which all the Dynasties of the past have had to grapple are two-fold, Drought and Inundation.

The excavation of Lake Moeris far away on the upper reaches of the Nile, which served as a reservoir for the regulation of its flow, was one of the greatest engineering feats of antiquity. It brought into subjugation the raging floods, and released them only as the needs of the lower valley required. These floods were necessary to the very existence of the people along the lower valley, and it was because he foresaw that this great fountain of life would fall unto the hands of the Theban King "who knew not Joseph" that

this virtuous statesman foretold the seven lean years and bade Pharaoh lay up corn against them. It is nevertheless true that these floods when released had to be controlled by levees to prevent destructive overflow of the deltas to be irrigated.

These levees extend along both banks of the Nile, just as they do along the Mississippi River, but beginning on the upper reaches other dykes are constructed running at right angles to the main levee across the valley at varying distances, making a checkerboard of levees throughout the entire area. These latter lines are built in the interest of irrigation, which is necessary because there is no rainfall, and for 500 miles below the confluence of the White Nile and the Blue Nile there is not a single tributary.

The Nile in flood time is considerably above the level of the country from Assuan to the Sea. In upper Egypt a very high flood is about four feet above the country; in middle Egypt about eight feet, and in some places along the lower reaches of the river it is as much as twelve feet higher than the adjacent country. In 1861, 1863, 1866, 1869, 1874 and 1878 there were crevasses in these levees which caused great destruction both of life and property. Sir William Wilcocks in the lecture above referred to, states that the destruction of life and property in the floods of '63 and '78 was very great—"the whole Western half of the delta proper was swept by the river and as the canals there have not got good high banks the people had no place of shelter to flee to and were drowned in very great numbers. The same thing would happen again if a breach were to occur now, only the damage would be far more serious. The country is covered with villas and rich plantations, and the low lands to the very edges of Lake Borrallos are unclaimed and uninhabited. A breach anywhere within 100 kilometres of the Barrage during a very high flood would be a national disaster."

The following description of a flood scene on the Nile reads almost as though it were an extract from a press despatch from the lower Mississippi:

"The terror reigning over the whole country during a very high flood is very striking. The Nile banks are covered with booths at intervals of 50 metres; each booth has two watchmen, and lamps are kept burning all night. Every danger spot has a gang of 50 or 100 special men.

The Nile is covered with steamers and boats carrying sacks, stakes and stones, while the banks along nearly their entire length are protected by stakes supporting cotton and indian corn stalks, keeping the waves off the loose earth of the banks.

* * * * *

The news that the bank had breached spread fast through the village, the villagers rushed out onto the banks with their children and cattle and everything they possessed. The confusion was indescribable. Narrow banks covered with buffaloes, children, poultry and household furniture. The women assembled around the local Saints' tomb, beating their breasts, kissing the tomb and uttering loud cries."

Sir William concluded this most interesting and instructive lecture in these words:

"Four thousand years ago Egypt stood at the parting of the ways and adopted a system of water storage and flood control suited to basin irrigation which served the country well for thousands of years. Today Egypt stands again at the parting of the ways and may it be her destiny to adopt a system of water storage and flood control suited to perennial irrigation which may stand her well for the thousands of years which may yet have to come."

The waters of the Tigris and of the Euphrates were confined to their banks by a system of levees "in the days when the good Queen Simiramis was dazzling the Assyrian nobles with the gorgeous splendor of her Court, and enslaving the hearts of those young gallants with the lustre of her wondrous eyes."

When the Renaissance raised the clouds which had kept Europe in darkness for so many centuries, we learn that levees extended for many miles along the river Po. About A. D. 1300 they were extended much further until about the beginning of the last century they had been completed to its mouth. In Holland the levee system has been carried further than in any other country in the world and it is estimated that they have cost to date more than \$1,500,000,000. Immense areas which were formerly submerged to a depth of 15 feet by the North Sea, have been successfully protected against these destructive tides. Perhaps the most stupendous undertaking was the reclamation by means of levees of the Zuyder

Zee. This great lake is supposed to have been formed in the thirteenth century by terrible storms which swept the North Sea into the low country, drowning some ten thousand people. In 1894 a great levee was constructed which shut out the North Sea and one million acres of land were reclaimed, at an estimated cost of ninety-five dollars an acre. Levees, in fact, have been constructed for the purpose of controlling floods on nearly every river of Europe and Asia. On the Rhone, the Danube, the Volga, the Yellow River, the Po, the Vistula, the Arno, the Rhine, and in fact all rivers where the valley is subject to annual inundation.

The theory then is no new one, and all the phenomena in any way related to river regulation and flood control by this means, have been subjected to the test of time.

THE LEVEE SYSTEM OF THE MISSISSIPPI RIVER.

The levee system of the Mississippi River has gone hand in hand with its civilization. The first settlements by Europeans in the lower valley of the Mississippi were at New Orleans and Natchez. The heights around Natchez of course rendered the construction of levees unnecessary there, but at New Orleans precautions were necessary to protect the settlers from overflow, and had to be taken at once. In 1717, De la Tour, the engineer who laid out the city of New Orleans, constructed the first levee along the river front, which was completed ten years later, extending for about eighteen miles above the city. As the country was gradually settled by immigrants, the levees were extended up stream, each planter building the line along his river front. The system was extended in this desultory way as the country was slowly settled, and in 1812, Stoddard in his history of Louisiana tells us

"these banks (levees) extend on both sides of the river from the lowest settlements to point Coupee on one side, and to the neighborhood of Baton Rouge on the other, except where the country remains unoccupied."

This was the situation when Jefferson purchased Louisiana.

By 1828, according to the Delta Survey (Humphreys and Abbott), the levees had been extended as high up as Red River Landing on the West bank and to the high bluffs at Baton Rouge on the East Bank.

By 1844, according to the same authority the line had been extended as far North as Napoleon, Ark., on the West bank, and disconnected sections extended more or less along the Yazoo Basin. Quite an impetus was given to levee building in 1850 by the passage of

THE SWAMP AND OVERFLOW LAND ACT.

This law gave to the various states of the Mississippi Valley

“the whole of those swamp and over-flow lands made unfit thereby for cultivation, which shall remain unsold at the passage of this act;”

the proceeds of the sales of these lands to be devoted by the states “to the construction of levees and drains.” The purpose to which the money so derived was in fact devoted by the various states which participated in the distribution depended entirely upon local conditions. In the states north of the mouth of the Ohio River the money was devoted to draining these swamp and overflowed lands into the tributaries of the Mississippi River, the natural and inevitable result of which was to increase the flood heights of the lower reaches of the river. The purpose to which the money so derived was devoted along the reaches of the river below Cairo was to the construction of levees which had to be made higher and stronger to give vent to the increased flood heights occasioned as above related.

In a very elaborate report on the Over-flows of the Delta of the Mississippi, prepared under instructions from the Secretary of War by Chas. Ellet, Jr., in 1850-1852 (Senate executive Doc., 20, 32d Cong., 1st Ses.), the disastrous effect of the extensive drainage of the lands in the upper valley upon the riparian lands in the lower reaches of the river, was set out in great detail. The following extract is reproduced from this report:

“It is not for one acting for the moment as an officer of the government to criticise the past, or to dictate the future, legislation of Congress; yet it may not be inappropriate to say, that if the vast bonus granted for the purpose of excluding the water from the swamps above, and sending it down upon the States below, had been accompanied by an adequate appropriation to enable those States below

to give vent to that water, or to protect their borders from the deluge which it will bring, the good which was intended by the grant would have been accompanied by less destruction than is now certain, without additional legislation, to follow the donation.

* * * * *

The process by which the country above is relieved is that by which the country below is ruined."

The following taken from the report of Humphreys and Abbott gives in detail the condition of the levees along the entire line when the great flood of 1858 came. This flood was the greatest which had ever come down the river. Its volume measured at Columbus, Ky., showed 1,475,000 cubic feet per second and many levees were breached. Referring first to the levees along the St. Francis Basin, the report states:

"The levees had all been made since the flood of 1851 and consequently had never been tested. They were much too low, hardly averaging 3 feet in height, although some of them across old bayous, were of enormous size, as, for instance, a short one near the northern boundary of Crittenden County, which was reported to be 40 feet high, 40 feet wide at the top and 320 feet wide at the bottom. Generally their cross-section was much too small, and, upon the whole, they were quite inadequate to effect the object for which they were intended.

From the mouth of St. Francis River to Old Town, the levees were complete. Between this place and Scrub-grass bayou, there were several gaps, amounting to about 14 miles. Thence to Napoleon there were no levees. Between Napoleon and the high land, south of Cypress creek, there were only about 3 miles of levee. Thence nearly to Point La Hache, below New Orleans, the embankments were completed.

On the left bank, excepting a few unimportant private levees, there were no artificial embankments between the mouth of the Ohio and the southern boundary of Tennessee. The near approach of the hills to the river, throughout the greater part of this region, has the effect of flooding by hill drainage the narrow belts of swamp land, and there is no immediate prospect of any attempt to reclaim them. Whether leveed or not, they are too trifling in extent to have any sensible influence upon the high-water level of the Mississippi River.

The Yazoo bottom below the Mississippi State boundary was considered to be well protected by levees. They, however, averaged only about 4 feet in height, and having been mainly constructed since 1853, had never been tested by a great flood. They were much too low and too narrow, as the flood of 1858 proved. The levee which closed the Yazoo pass was an enormous embankment across an old lake. It was 1,152 feet long, and 28 feet high, with a base spread out to the width of 300 feet. About 10 miles of gaps in Coahoma and Tunica counties (between Islands 51 and 67) had been closed in the winter of 1858, and consequently the levees had not had time to settle properly before the occurrence of the high water. There was only one open gap. It was nearly opposite Helena, and had been caused by a caving bank.

Between Vicksburg and Baton Rouge, on the left bank, the levees were complete where there was any occasion for them. The hills approach so near to the river in this part of its course, that the bottom lands are limited in extent, and hence somewhat liable to injury from sudden upland drainage."

The damage done by the floods of 1858 and 1859 had been repaired and great progress was being made in the further extension and strengthening of the line when, in 1861, grim visaged war showed his wrinkled and most horrid front.

GREAT DISASTER OF THE WAR BETWEEN THE STATES.

It is impossible to overstate the extent of this disaster to the industrial development of the deltas of the lower Mississippi.

The valley was literally and utterly laid waste. Here in truth the cry of Havoc was heeded when they let slip the dogs of war. The ruin which was general throughout the South was greatest in the alluvial deltas, where the planters shared the common disaster with their neighbors in the hills, and in addition, suffered the wreck of their properties caused by the increasing and unresisted floods of the next ten or fifteen years. To illustrate the measure of this disaster the following figures from the Census Bulletin will be interesting: Farm property in 1850, in the States of Arkansas, Mississippi and Louisiana, was valued at \$201,963,344; in 1860 it had risen to the enormous sum of \$607,385,474; more than 300 per cent increase in ten years! In 1870 it was listed at \$213,885,602,

a decrease of \$400,000,000 in ten years! In addition to this, the entire labor system had been revolutionized, and a veritable saturnalia of misgovernment, which would be dignified beyond its deserts by calling it chaotic, added horror to the general wreckage. Then as a fitting cap to this climax of misfortunes, Congress imposed a tax of 3c a pound (about \$15.00 a bale), on all cotton produced for the 3 years of '66, '67 and '68. In the meantime the Star of Empire had led the ever industrious, enterprising and aspiring youths of the older states, and the army of homeseekers who sought refuge in this free country from the hardships and oppressions of the old world, into the great states along the upper reaches of the Mississippi and the Missouri. The wilderness was subdued; the prairies were peopled with virile and industrious farmers; thousands, aye, tens of thousands of swamps, marshes and an infinite variety of natural reservoirs were drained precipitately into the great tributaries, causing each succeeding flood to rise higher, and making the task of its control annually the more difficult.

The riparian owners, nevertheless, in spite of their unhappy situation, continued their struggle against the great floods which were poured down annually upon them from the rapidly developing states of the upper drainage basis, but they were unequal to the ever-growing burden.

THE GREAT FLOOD OF 1874.

The great floods of 1862, 1865, and 1867 had almost destroyed the levees which had been so nearly built up to standard when Humphreys and Abbott filed their report in 1861 (Sen. Ex. Doc. 8, 40th Cong., 1st Sess.). Then in 1874 came what proved in many sections of the delta to have been the most disastrous of all floods. The utter wreck and desolation of this once happy valley seemed as complete as it was cruel.

One-half of the lands behind the levees was sold by the tax collector in a vain but desperate effort to work out salvation unaided by the government at Washington! It was perfectly evident that either the great alluvial deltas must be abandoned to the jungle, and this, the most fertile valley in the world, lapse again into "some vast wilderness, some boundless contiguity of shade," or the Federal Government must come to the rescue.

No relief came, however, from that source, and the prospect of an enforced abandonment of the whole delta country grew sadder and more certain with the monotony of its recurring floods.

THE COLLAPSE OF THE LOCAL LEVEE SYSTEM.

In 1882, '83 and '84 the deltas were visited for the first time by three successive and excessive floods. In 1882 there were 284 crevasses; in 1883, 224; in 1884, 204; 712 crevasses in three years!

In his report to Congress heretofore referred to Mr. Ellet had foretold with prophetic words how the drainage of the great plains along the upper reaches of the river would surely overwhelm the deltas along the lower river unless Congress should help the people there to build their levees higher and stronger.

"The process by which the country above is relieved is that by which the country below is ruined." This was the report of 1852. Now mark how well the sequel held together. In 1850 farm values in the eleven great states between the Missouri and the Ohio Rivers was given by the Census at \$827,577,776. The great flood of 1858 measured 1,475,000 cubic feet per second. In 1880, farm values in the same eleven states, indicating the measure of their improvement, was given at \$5,317,880,906, and the flood of 1882 measured 1,800,000 feet per second! In the light of these facts how pregnant of truth, how prophetic, are these words quoted from the same report:

The true difficulties of this problem will now be appreciated. We can protect Louisiana by simple means from all ordinary natural floods. But the great problem with which we have to cope is, to ascertain how to protect her from the deluge created by the artificial improvements which are accelerating the drainage of the prairies, and diverting the collected waters from their natural course through the lowlands.

It will thus be seen that it is the pursuit of individual and public interests through all of the northern states of the Mississippi valley that pours the excess of water down. It may possibly be considered, therefore, that it is the common duty of the states to guard the land which these improvements now endanger.

These floods had at least answered once and for all the mooted question of the ability of the riparian owners to protect themselves against the ever increasing volume of flood water. In these three years the planter had been despoiled of stock, of tenants, and of credit—"all his little chickens and their dam at one fell swoop."

It was no longer a theory. Without the aid of the Federal Government the delta must be returned to the denizens of the jungle from whom it had been won and the fight for its civilization must be abandoned. This was not conjecture. The prostrate body lay before Congress. There was the proof which Horatio required upon the platform at Elsinor: "The sensible and true avouch of their own eyes."

Conventions were held in the Delta to discuss the advisability of continuing the unequal struggle against the increasing floods. The question was most seriously debated whether to give up the fight and surrender that fertile and now beautiful valley to the jungle. I quote from the statement of Senator Percy in the hearings:

Before the Federal Government had indicated a willingness to help in this work, the Yazoo Delta, more favorably situated with regard to levees than any other district on the river, because it is a great basin divided into two districts with only one outlet, and therefore there is no difficulty arising out of the feasibility of protection by the levee system—in 1880 more than 50 per cent of the land of the Yazoo Delta had gone back to the State of Mississippi to pay levee debts. In our efforts to protect ourselves by our own taxation we had taxed out of the hands of individuals back into the hands of the state, where it yielded no revenue, either for state or county purposes, more than one-half of the total acreage of that Delta. The fight was over and we were whipped. And elsewhere along the river, in the great majority of places, no levee districts had been formed. Then the Government came in and held out a hope—it was not what they expended, because it was comparatively little—which gave a fictitious sense of security to the people, and they took heart and borrowed money on credit, based on belief in Federal aid.

These brave men blessed with courage and energy, and vigor and determination, the characteristics of that matchless band who had wrested the wilderness from the savage and carved the name "American Pioneer" upon the rock of ages; in the most fertile spot

in that great valley aptly called the cornucopia of the world; in the prime of a vigorous and virile manhood, in a land blessed above all others with sunshine and shower, for the first time in the history of their race gave up the Divine Commission "to subdue the earth," and surrendered!

In the Yazoo Basin, the richest and most easily protected of all the deltas, one-half of the land was forfeited for taxes. The riparian owner had kept the faith, he had fought the good fight, but he was whipped! Verily he could have exclaimed in righteous humiliation: "After me the deluge!"

Let it be borne in mind that it was not the levee system which collapsed. It was that system *when left solely to the people of the deltas to maintain*. Having turned for awhile to trace the long fight waged in Congress from the earliest days to enlist the Federal Government as an ally, we shall return to our story and see how hope was revived, and the battle lines reformed under the leadership and direction of the Mississippi River Commission.

THE LONG FIGHT FOR FEDERAL AID.

The control of the floods of the lower Mississippi is a subject which has vexed the minds of both the statesmen and engineers of this country from the date when jurisdiction of the entire river was transferred to the Federal Government by the Treaty which consummated the Louisiana Purchase. Just to what extent the Federal Government should undertake to improve the river has been the mooted question. From the beginning there have always been those who insisted that whatever works of improvement were carried on by the Federal Government, should be solely in the interest of the navigation of the river. On the other hand there has been an equally insistent demand that the control of the flood waters of the lower river because of the magnitude of the problem, the extent of the area to be protected, the almost immeasurable potentialities of these fertile acres, was a national problem.

The navigation of the Mississippi River was one of the most important, as it was one of the most exciting questions which commanded the attention of the residents of the valley in the early years immediately succeeding the Louisiana Purchase.

In fact the great dissatisfaction of the people beyond the Allegheny Mountains over the question of free navigation of the Mississippi River was one of the pegs, if not the main one, upon which Aaron Burr hung his hopes for a separate empire in the West. The transfer of Louisiana to the Union guaranteed "the free navigation" of the river to the sea, unobstructed by political agents of any foreign government, but the dwellers of the valley complained most bitterly that the stream filled with snags and other obstructions was, in fact, no more "free" than when the haughty Don obstructed the passage.

Henry Clay in an impassioned speech in the Senate complained:

"Around the region of the coast of the Atlantic, the Mexican Gulf and the Pacific coast, everywhere, we pour out in boundless and unmeasured streams the treasure of the United States, but none to the interior of the West, the valley of the Mississippi. Every cent is contested and

denied for that object. Sir, I call upon the Northwestern Senators, upon Western Senators, upon Eastern Senators, upon Senators from all quarters of the Union, to recollect that we are part of our common country."

This was in answer to the suggestion that the improvement of the river in accordance with a suggestion of the army engineers, was really a local and not a national question.

THE FIRST OFFICIAL REPORT ON THE MISSISSIPPI.

In 1822 Bernard & Totten, of the Army Engineer Corps, after a very extensive and elaborate study of the river made a report in which they declared (H. Doc. 35, 17th Cong., 2nd Sess.):

"The only means (of improving navigation) which appear practicable to us is the construction of dikes. They operate by diminishing the current above them, thus economizing the expanse of water, at the same time constraining the current to rush with greater velocity through the narrow space to be deepened.

While the waters of this river are over its banks, the operation of the current being in proportion to its elevation and consequent increase of velocity, the changes which are produced in the bed of the river are great, sudden and numerous."

This was the very first official report on the river. There have been many investigations since then; much elaborate study; almost limitless investigation and observation; in fact, it can be said with no exaggeration that no river in all the world has been observed with such relentless scrutiny as has the Mississippi during the century since it passed to the control of the United States. It is a high tribute to the engineering skill and judgment of Bernard and Totten that every board of engineers, civil and military, which has been called upon to study and report upon the subject since their day has agreed to their conclusion "that the only means which appear practicable to us is the construction of dykes."

Nothing came of this report however, but the floods which continued, particularly the two great overflows of 1828 and 1844, stirred the people in the valley to the liveliest activities. Without the controlling influence of levees innumerable sand bars were habitually formed in the channel which at many places was less than three feet deep. On these bars the logs and trees which were an-

nually washed into the main stream were accumulated, forming very dangerous obstructions to the passage of all water craft. Bernard and Totten had reported in 1822 that "the only means (of improving these conditions) which appears practicable to us is the construction of dykes," and the people of the entire valley set about in a most determined fashion to have Congress undertake this work.

MEMPHIS CONVENTION OF 1845.

In 1845 a Convention of the Southern and Western States was held at Memphis, Tennessee, for the purpose of considering the general interests of the Southern and Western States and particularly the improvement of the Mississippi River.

John C. Calhoun presided over the convention and upon taking the chair made a notable speech in which, among other things, he said:

"He did not, himself, believe in the power of the General Government to conduct a system of internal improvement. He had, independently of other objections, seen the evil effects of it, in too many instances, where it has been attempted, and the system of log-rolling which ensued; but, in relation to the great highway of western commerce, at least, the great inland sea of the country—the Mississippi—he did not, for a moment, question that government was as much obligated to protect, defend, and improve it in every particular, as it was to conduct these operations on the Atlantic seaboard. It was the genius of our Government, and what was to him its beautiful feature, that what individual enterprise could effect alone, was to be left to individual enterprise; what a state and individuals could achieve together, was left to the joint action of states and individuals; but, what neither of these, separately or conjoined, were able to accomplish, that, and that only, was the province of the Federal Government. He thought this was the case in reference to the Mississippi River."

(De Bow's Review, Vol. I (1846), p. 14.)

This convention adopted a set of resolutions. The one touching the Mississippi was as follows:

"Resolved, That millions of acres of public domain, lying on the Mississippi River and its tributaries, now worthless for purposes of cultivation, might be reclaimed by

throwing up embankments, so as to prevent overflow; and that this convention recommend such measures as may be deemed expedient to accomplish that object, by grant of said lands or an appropriation of money."

These resolutions were subsequently presented to Congress in the form of a memorial and referred to an appropriate committee. The following extract from this memorial will prove interesting:

"The expenditures on the Mississippi thus far, if reports are to be credited, have produced no results corresponding to the vast sums appropriated. When the channel has been straightened at one point it has been lengthened at another, and obstructions or deposits in one bend have only been transferred in their removal to another. 'Sawyers' and 'Planters' have in one season been reduced in number to be replaced by the succeeding one.

"The only fact clearly established, and it is one to which attention should be particularly directed as bearing with peculiar influence on the proposition submitted, is that where the banks of the Mississippi have been leveed and prevented from inundating the swamps, the spring rises are scarcely perceptible, and the surplus waters are discharged by deepening the bed; its currents no longer able to rise and expand over a wider surface, they have to deepen the bed to furnish vent for the waters to be discharged. The reclaiming, therefore, the swamps and confining the river to its bed will deepen it, and do more to preserve unimpaired the navigation of the Mississippi than all the projects which have hitherto been devised or acted on for its improvement. The suggestion, however, is worthy of examination, and it is the stronger recommended as it may accomplish a great object at comparatively little cost. *The swamps of the Mississippi now worthless, and made so by the inundations of that river, may be made, by their own reclamation, the instruments of improving the navigation of that stream.*"

Once again it had been ascertained that the river could not be improved without the construction of levees along its banks, but as these levees, though absolutely necessary in the interest of navigation, would nevertheless protect vast areas of fertile privately owned lands from annual over-flow, objections were persistent, and frequently potent, that this was not a national question.

Mr. Calhoun on behalf of the committee reported the resolutions to the Senate in an elaborate report (Senate Doc. 410, 29th Congress, 1st Session). Referring to the particular resolution above quoted, the report stated:

"As fertile as this great body of land is, by far the greater part is at present of little or no value, in consequence of its swampy character and being subject to inundation, and must remain so; alike unprofitable to the public and individuals, so long as they may remain in their present condition. But they must remain so until reclaimed by embankments. To meet the expense of making them, the convention recommends the grant of lands, or appropriation of money by Congress."

It concluded with a recommendation that these lands be "ceded to the states in which they may respectively lie."

CHICAGO CONVENTION OF 1847.

In 1847 as a result of continuous agitation through the valley a national convention was held in the city of Chicago to consider the general subject of the Commerce and Navigation of the Valley of the Mississippi.

Thos. H. Benton, then a senator from Missouri, addressed a letter to the delegates, very strongly endorsing the general purpose of the convention and particularly urging the proposition that it was the duty of the Federal Government to improve the Mississippi River. Extracts from this letter will be found elsewhere (p. 106), setting forth his views as to the constitutional questions involved, and also his ideas as to the national quality of the project.

Another great convention was held at Cincinnati, with the net result that the public sentiment aroused by these repeated meetings at last found expression in the halls of Congress, and brought the nation to a realization of the fact that the responsibility was upon Congress and that the great interests to be conserved by the proper improvement and control of the river were so tremendous as to transcend the possibility of local solution and mounted to the high dignity of a national problem.

Recognizing the justice of this contention, Congress enacted the law of September 28, 1850, known ever since as the Swamp and Overflow Land Act.

This law gave to the various states of the Mississippi Valley all the wet lands then remaining unsold, the proceeds of their sale to be devoted to their reclamation by levees or drains. This was the first appropriation by Congress in the aid of levee construction, but the effects of the draining of the low lands in the states in the Northern part of the valley so increased the flood heights on the lower river that the situation there grew steadily worse. (See p. 63.)

HUMPHREYS AND ABBOTT'S REPORT.

In addition to the "Swamp and Overflow Act" of 1850, elaborate surveys of the Mississippi River were authorized, which resulted in two noteworthy reports; the one elsewhere referred to (p. 34), by Mr. Chas. Ellet, made in 1852, the other by Captain A. A. Humphreys, in collaboration with Lieut. Abbott, both of the army engineer corps.

These two eminent engineers devoted ten years to the study of the subject in hand, and in 1861 made a report to Congress on the Physics and Hydraulics of the Mississippi River which has since that time been regarded by all students of river hydraulics as the standard classic. Many theories are advanced for the control of the flood waters of the Mississippi River after every disastrous flood. Public prints are filled with articles written by those who believe they have made a great discovery. The levee system is condemned as a failure and what the writer honestly, though erroneously, believes to be a new idea is proposed. It is interesting to read in the very elaborate report of Humphreys and Abbott how all these so-called new theories were put to test long before the present generation was born.

This report contained the following:

"Analysis of Plans for Protection:

Three distinct systems have been proposed for the protection of the bottom lands against overflow. These are: First, to modify the actual relations existing between the accelerating and retarding forces in the channel, in such a manner as to enable the former to carry off the surplus floodwater without so great a rise in the surface as they now require. *To this system belong Cut-offs.* Second, To reduce the maximum discharge of the river. To this

system belong *diversion of tributaries, artificial reservoirs, and artificial outlets*. Third, to confine the water to the channel, and allow it to regulate its own discharge. To this system belong *levees, or artificial embankments*. Each of these systems has its advantages and its disadvantages. Before deciding, then, upon the best practical system of protection from the floods of the Mississippi, each system must be examined in respect to its feasibility, its dangers and its cost as applied to that river. This will be done separately for each plan in turn."

Each of these plans is then discussed most elaborately and treated both from the scientific standpoint of the engineer as well as from the historical point of view. All the rivers of the world which had been subjected to the skill of the engineer were studied, and their conclusions on these *new* theories stated thus:

"It has been shown by the preceding discussion that a cut-off raises the surface of the river at the foot of the cut nearly as much as it depresses it at the head. The country above the cut is therefore relieved from the floods only at the expense of the country below. Moreover, if a series of cut-offs were to be made extending to the mouth of the river, the principles deduced show that the heights of the floods would be regularly decreased from a point near midway of the series to the upper end, and regularly increased from the same point to the lower end. The system, therefore, is entirely inapplicable to the Mississippi river, in whole or in part."

The next plan considered was that of diversion of tributaries. This whole subject is elaborated and illumined by a discussion of every detail and its utter impracticability demonstrated.

The next question was the plan of the reservoir. This is discussed at great length and the question viewed from every angle and the conclusion stated in these words:

"The idea that the Mississippi delta may be economically secured against inundation by such dams has been conclusively proved by the operations of this Survey to be in the highest degree chimerical."

The next question considered was the plan of outlets and after the same elaborate discussion and investigation which was unvaryingly devoted to all plans, the conclusion as to outlets is thus stated:

"Enough has been said to demonstrate, with all the certainty of which the subject is capable, the disastrous consequences that must follow the resort to this means of protection."

The next plan considered was the levee system. Twenty pages of this large report were devoted to the discussion of the levee system. The experience of all countries was available, as well as the experience of our own people on the Mississippi river since the levee system was first inaugurated in 1717.

The report of Mr. Ellet recommended as means by which the floods of the Delta could be prevented: first, levees; second, the prevention of cut-offs; third, outlets; and, fourth, reservoirs. He is the only engineer who has made a study of the Mississippi River, so far as I have been able to ascertain, and who recommended reservoirs as a practical and efficient means of preventing floods in the lower Mississippi. In submitting Ellet's report to the Secretary of War, Col. J. J. Abert, of the Corps of Topographical Engineers, dissented on this point. He said:

"He also calls to his aid a fourth accessory means of controlling these floods; that of reservoirs in the mountain gorges near the heads of the principal streams. While I willingly admit that all the speculations of a man of intellect are full of interest and deserving of careful thought, yet I cannot agree with him that these reservoirs would have any good or preventative effect upon the pernicious inundations of this river, and even doubt if the water so proposed to be collected would have any appreciable and certainly not an injurious effect upon the inundated region. These reservoirs can, of course, collect only the waters which shall drain into them and can have no possible influence upon other waters below the reservoir draining space; or, in other words, from the immense plateau or country which lies between the head waters of these rivers, or below points where gorges for reservoirs would probably be found. My impressions are that the pernicious inundations of these rivers are consequent only from a general rain or a general and rapid thaw of the snow over this immense plateau. The calculation of downfall water has direct reference to this extensive plateau and unless it can be shown that the vast supply of water from this plateau, or a large portion of it, would be collected and restrained

by these reservoirs. I do not perceive their advantage to the system proposed to be adopted."

Humphreys and Abbott, having devoted ten years, as above stated, to the consideration of the whole subject in all its phases, and having digested all plans which had been suggested by Mr. Ellet, concluded their report in 1861 with the following recommendation:

"The preceding discussion of the different plans of protection has been so elaborate and the conclusions adopted have been so well established, that little remains to be said under the head of recommendations. It has been demonstrated that no advantage can be derived either from diverting tributaries or constructing reservoirs, and that the plans of cut-offs, and of new or enlarged outlets to the gulf are too costly and too dangerous to be attempted.

The plan of levees, on the contrary, which has always recommended itself by its simplicity and its direct repayment of investments, may be relied upon for protecting all the alluvial bottom lands liable to inundation below Cape Girardeau. The works, it is true, will be extensive and costly, and will exact much more unity of action than has thus far been attained. The recent legislation of Mississippi in organizing a judicious State system of operations, however, shows that the necessity of more concert is beginning to be understood. When each of the other States adopts a similar plan and all unite in a general system so far as may be requisite for the perfection of each part, the alluvial valley of the Mississippi may be protected against inundation."

Such was the conclusion of these great engineers at the end of the ten-year Herculean task!

Upon the filing of this report in 1861 special committees were created by Congress for the consideration of the subject of the improvement of the Mississippi River, but the war between the states, which followed shortly thereafter, brought the whole subject abruptly to an end.

The destruction of the levees which had been built prior to the war, by the floods of 1862-65, has been stated (p. 23).

In 1866, Congress directed the Chief of Engineers to examine and report upon the condition of the levees, giving an estimate of the amount that would be required to repair the breaches which had

occurred. In the report of Genl. A. A. Humphreys, which followed, this significant language appears (Sen. Ex. Doc. 8, 40th Cong., 1st Sess.):

"I have excluded from consideration, as not coming under your instructions, those cases where the levees have been virtually destroyed along so great an extent of river front, that their repair would be practically the rebuilding of the levees of that section of country."

President Johnson, realizing the wretched plight of the residents of the deltas and their hopeless inability to cope with the great floods unaided, in vain urged Congress to come to their assistance (p. 12).

The report showed that in order to repair the breaks, which were technically only breaks in an existing line, and leaving out of consideration the long sections which had been washed away or caved into the river, would require an appropriation of \$3,900,000. The report further stated:

"There are now under cultivation in this region about 1,000,000 acres.

Of the remaining 19,400 square miles, perhaps, 3,000 square miles within that region of the most fertile alluvion, two-thirds of which may be finally rendered cultivable under a proper system of leveeing and draining. This would give 7,000,000 acres of cultivated land, capable of giving a bale of cotton to the acre, or about double the whole cotton crop of the United States in 1860.

The levees constructed under such a system would not, when greatest, exceed in magnitude those on the right branch of the Rhine below Arnheim, which protect the most fertile part of Holland. These levees are exposed at high water to as strong a current as that on the Mississippi in flood, and also to the destructive effects of ice. But the occurrence of crevasses such as take place with every flood of the Mississippi are there unknown. Should they happen, the ruin of a large part of the most productive portion of Holland would follow, as extensive tracts protected by the levees are lower than the surface of the sea, and their reclamation from overflow could only be effected by a drainage similar to that which has been applied to the lake of Harlem. The supervision, watching, and repair of these levees is costly; but effective and remunerative. The levees of the Mississippi as now existing

are trifling compared to the interests they protect and to the levees of the delta rivers of Europe, the Po, the Rhine, and the Vistula.

* * * * *

The proper establishment and maintenance of the first order of levees requires *some authority entirely beyond the influence of local interests.*"

Congress failed to take the necessary action and the "process by which the country below was ruined" continued.

THE WARREN COMMISSION AND ITS REPORT.

Following, and no doubt in large part induced by, the disastrous floods of 1874, described elsewhere (p. 23), Congress once again created a commission composed of eminent engineers to investigate the subject and report. This commission was headed by Gen. G. K. Warren, and its report, which was submitted Jan. 18, 1875, and printed as H. Ex. Doc. 127, 43rd Cong., 2nd Sess., covered the entire subject in a most elaborate work of 160 pages. This commission, as had all others, declared that the only method by which the deltas could be protected from overflow was a levee system, but it was further of the opinion that there must be one general system of levees to take the place of the various state organizations which had been attempting to solve the question unaided by the federal government.

"In fine," states the report, "the experience of over one hundred and fifty years has utterly failed to create judicious laws or effective organization in the several states themselves, and no systematic cooperation has ever been attempted between them. The latter is no less important than the former, for the river has no respect for state boundaries, and deluges Arkansas through breaks in the levees of Missouri, and overflows Louisiana by floods passing across the Arkansas line.

"It is a common and apt figure of speech to personify the Mississippi, and to speak of the conflict waged to protect the country against the inroads of a terrible enemy, and yet the army of defense has always been content to remain a simple aggregation of independent companies, with here and there a battalion under the command of a board of officers. That victory has not more frequently perched upon their banners is surely not surprising."

The statement that the army of defense had always been "content" to remain a simple aggregation of independent companies was of course inaccurate. The efforts to secure congressional aid which would put the whole subject matter under one command with a single head—the federal engineer—are vividly set forth throughout the debates in Congress on the subject for many years prior to this report. Congress had apparently been content, but certainly not the "army of defense."

The report also showed that from October, 1866, to October, 1874, 107 miles of levees had caved into the river in the state of Mississippi alone!

The report, after demonstrating that the levees would have to be built higher and stronger quoted with approval the reference to the levees on the Rhine below Arnheim in the report of Gen. Humphreys reproduced above, and concluded as follows:

"Whether the funds necessary to carry this system into operation shall be loaned or appropriated by the General Government, or be raised by general taxation in the states interested, or be supplied by the owners of the lands to be reclaimed, does not properly come within the province of this commission to recommend. *We are, however, satisfied that in the present impoverished condition of the country but little can be done, either by the states or the landed proprietors, unaided by the General Government.*"

THE MISSISSIPPI RIVER COMMISSION.

About this time Capt. James B. Eads came into national prominence as one of the great authorities on river hydraulics. The construction of the Eads bridge at St. Louis and the Jetties at the mouth of the river had given him a popular fame perhaps unequalled by that of any other engineer of that day, and his name was therefore one to conjure with. He appeared before a committee of Congress and declared that in his opinion it was entirely possible and feasible so to improve the Mississippi River within the limits of reasonable cost as to give it depth sufficiently ample for all purposes of navigation and at the same time to prevent the overflows of the lower river which worked such destruction of property.

Bills were introduced and the debates in Congress extended through several sessions, some of the most distinguished members of all parties and from all parts of the Union frequently taking part. A bill to create a commission with authority and money to aid in the work of levee building was reported and earnestly supported by representatives from eastern and western constituencies. Mr. Robinson, of Massachusetts, among other things, said:

"The committee have found these two subjects to be interdependent. They have not seen in the investigation they have given that the one necessarily stands apart from the other. All the writers and all the engineers from whom they have heard declare that in some measure, greater or less, the protection of the lands have also an influence upon the navigable character of the river. * * * This bill is intended to provide a commission to devise a plan for the improvement of the Mississippi River and the protection of the alluvial lands combined. If as a part of the whole plan for the improvement of the river for the purposes of navigation, and incidental thereto, the lands of the valley may be protected, I am in favor of it."

General Nathaniel P. Banks, also then a member from Massachusetts, supported the bill. I quote from his speech as follows:

"I have already stated that the improvement of the alluvial lands is incidental to this work. It cannot be separated from it. No declaration or act of Congress can prevent it. If we make the river what it ought to be we will make 40,000,000 acres of the best cotton and sugar lands on the face of the earth in consequence of the necessary improvement of the river—40,000,000 where now only 1,000,000 exists. It is inseparable from it and incidental to the improvement of the river."

Mr. Garfield, then a member from Ohio, styled the Mississippi

"the most gigantic, single, natural feature of our continent, far transcending the glory of the ancient Nile, or of any other river on earth."

And further declared his belief that

"one of the grandest of our material interests—one that is

national in the largest material sense—is this great river and its tributaries.

* * * * *

The statesmanship of America must grapple with the problem of this mighty stream; it is too vast for any state to handle; too much for any authority less than that of the nation itself to manage."

He urged an appropriation for the two-fold purpose of improving the navigation and protecting the valley from floods. This bill failed, but in the following Congress another was enacted (in 1879), creating the Mississippi River Commission, to be composed of three engineers from the army corps, one from the Coast and Geodetic Survey, two engineers from civil life, and one distinguished citizen. This distinguished citizen was Benjamin Harrison, afterwards President of the United States. Upon his elevation to this high office he appointed as his successor Judge R. S. Taylor, of Indiana, who has served upon the Commission ever since. Section four of the Act prescribed the duties of the Commission as follows:

"Sec. 4. It shall be the duty of said Commission to take into consideration and mature such plan or plans and estimates as will correct, permanently locate, and deepen the channel and protect the banks of the Mississippi River; improve and give safety and ease to the navigation thereof; prevent destructive floods; promote and facilitate commerce, trade, and the postal service; and when so prepared and matured, to submit to the Secretary of War a full and detailed report of their proceedings and actions, and of such plans with estimates of the cost thereof, for the purposes aforesaid, to be by him transmitted to Congress: Provided, That the Commission shall report in full upon the practicability, feasibility, and probable cost of the various plans known as the jetty system, the levee system, and the outlet system, as well as upon such others as they deem necessary."

FIRST REPORT OF MISSISSIPPI RIVER COMMISSION.

On the 17th of February, 1880, the Mississippi River Commission thus appointed made its first report, from which the following extract relating to levees is taken:

"There is no doubt that the levees exert a direct action

in deepening the channel and enlarging the bed of the river during those periods of 'rise' and 'flood' when by preventing the dispersion of the floodwaters over the adjacent lowlands, either over the river banks or through bayous and other openings, they actually cause the water to rise to a higher level within the river-bed than it would attain if not thus restrained.

While it is not claimed that levees in themselves are necessary as a means of securing ultimately a deep channel for navigation, it is believed that the repair and maintenance of the extensive lines already existing will hasten the work of channel improvement through the increased scour and depth of river bed which they would produce during the high-river stages. They are regarded as a desirable, though not a necessary, adjunct in the general system of improvement submitted.

It is obvious that levees are, upon a large portion of the river, essential to prevent destruction to life and property by overflow. They 'give safety and ease to navigation and promote and facilitate commerce and trade' by establishing banks or landing places above the reach of floods, upon which produce can be placed while awaiting shipment, and where steamboats and other river craft can land in times of higher water.

In a restricted sense as auxiliary to a plan of channel improvement only, the construction and maintenance of a levee system is not demanded. But in a larger sense, as embracing not only beneficial effects upon the channel, but as a protection against destructive floods, a levee system is essential; and such system also promotes and facilitates commerce, trade, and the postal service.

The foregoing is submitted as the opinion of this Commission, with regard to the attributes and functions of levees, and their general utility and value. The views of the several members, however, are not in entire accord with respect to the degree of importance which should attach to the concentration of flood-waters by levees, as a factor in the plan of improvement of low-water navigation, which has received the unanimous preference of the commission."

The particular matter about which there was not "entire accord" was stated in a minority report signed by General C. B. Comstock and Benjamin Harrison. Speaking of the levees in this minority report they say:

"While of the opinion that levees are essential to prevent injury to alluvial lands by destructive floods and that outlets should not in general be used, there are some less important points on which we do not concur in the views of the majority of the Commission. * * * For these reasons we are of the opinion that levees are of very little value in improving the low-water navigation of the river. *Of their necessity in protecting alluvial lands against destructive floods there can be no doubt*, and to obtain such protection the first step would be the closure of gaps in existing levees."

Shortly thereafter Mr. Garfield was nominated for the Presidency, and in accepting that nomination said:

"The wisdom of Congress should be invoked to devise some plan by which that great river shall cease to be a terror to those who dwell upon its banks, and by which its shipping may safely carry the industrial products of 25,000,000 people."

And in his annual message in December of the same year President Hayes said:

"These channels of communication and interchange are the property of the nation. Its jurisdiction is paramount over their waters, and the plainest principles of public interest require their intelligent and careful supervision with a view of their protection, improvement, and the enhancement of their usefulness."

The project defined by the Commission in its report above quoted was thereupon adopted by Congress, and an appropriation of one million dollars made in the following Rivers and Harbors Bill, approved March 3, 1881, the last day of President Hayes' term. This bill, however, provided:

"That no portion of the sum hereby appropriated shall be used in the repair or construction of levees for the purpose of preventing injury to lands by overflow or for any other purpose whatever, except, as a means of deepening or improving the channel of said river."

Congress had at last decided that the floods of the lower river should be controlled "in the interest of navigation," and had begun the construction of levees, but whether those levees should be

built high enough to withstand the highest floods, or just high enough and strong enough to be washed away when the crisis came was yet to be decided. Bernard and Totten had given the answer in their report in 1822. Ellet had given the same answer in 1852. Humphreys and Abbott had demonstrated the levee theory in their matchless report of 1861, and their conclusions had been endorsed by the Warren Commission in 1875. Another Commission had now been set to work upon the problem. What would their answer be?

The long fight for Federal aid had found fruition in this act creating the commission, and the people of the deltas again took hope. "The genius of our government and what was to him its beautiful feature," as formulated by Mr. Calhoun in the Memphis Convention of 1845, had been put to the test. The levee problem was one "which individual enterprise alone could not effect"; neither could "state and individuals achieve its solution when left to their joint action," and therefore as neither of these "separately or conjoined were able to accomplish it, its solution was the province of the Federal Government."

Let us now review the evolution of this problem under the administration of the Mississippi River Commission.

LEVEES UNDER THE ADMINISTRATION OF THE MISSISSIPPI RIVER COMMISSION.

The utter collapse of the local levee systems unaided by the Federal Government has been noted (p. 24). Let us turn to another page and watch the unfolding of events under a different dispensation.

Inspired by the hope which sprang up in their breasts when Congress at last put its hand to the plow, the people of the deltas set about to renew the fight and this time with great earnestness and enthusiasm.

Legislation was secured by the various state governments creating Levee Districts with full power to levy taxes, issue bonds and do all other things necessary to raise sufficient funds to meet the heavy burden about to be assumed.

Civil Engineers were employed by them to cooperate with the engineers of the Army and for every dollar appropriated by Congress they contributed two.

No system of taxation which the wit of man could conjure up was overlooked.

First, they provided an ad valorem levee tax, greater than the combined state and county taxes for all other purposes. This was collected on all assessable property, both real and personal. In addition to this they imposed an acreage tax. Then there was a tax on privileges, that is to say, a tax on every occupation from storekeeper to the man who drives a cart for hire. Nobody was exempt, except preachers and doctors. Then they had a produce tax, varying in different districts. A dollar a bale on cotton, a tax on every ton of hay, every barrel of sugar, every bag of rice, every gallon of molasses, *every barrel of oysters!*

The only system which escaped their tax assessors was the system adopted in Egypt, known as *corvee*. Corvee is the system by which the obligation is imposed upon all the inhabitants in the country to labor gratuitously on the levees. Yes, there is one other system which apparently was overlooked. Herodotus tells us that

the old Pharaoh, Sesotris, left many inscriptions upon the monuments erected by him in Egypt, in which he testified to the fact that the great dykes and embankments built by him along the banks of the Nile to protect their country from inundation, had been constructed by captives taken in war and "that no native was employed in the laborious part of the undertaking." It is evident from this that even in those ancient days distinguished gentlemen who held offices of high importance in the State paid proper regard to vox populi, and were careful to give assurance that the foreigner paid the tax! They had no prisoners of war in these deltas; the only ones were the convicts, and these were so employed.

The Act of June 28, 1879, creating the Mississippi River Commission, provided, among other things, that:

"The Commission shall take into consideration and mature such plans and estimates as will correct, permanently locate, and deepen the channel and protect the banks of the Mississippi River; improve and give safety and ease to the navigation thereof; prevent destructive floods; promote and facilitate commerce, trade, and the postal service."

There has never been any disagreement among the membership of the Commission since the day of its creation down to the present time as to the necessity or efficacy of levees as a means of flood protection, illumined as their experience has been during the past thirty odd years by long and varied experience with many floods, some of them the greatest in the history of the river. They now, and always, have unanimously agreed that the only way to prevent destructive floods is by the construction and maintenance of a levee line of sufficient grade and section to confine the river to its channel. The proviso contained in the first appropriation bill, and which was carried in succeeding bills, limited the construction of levees to such location and heights as would improve the channel of the river, without any reference whatever to the protection of alluvial bottoms from overflow. Just how high those levees should be, whether of sufficient grade and section to hold the greatest floods which come at long intervals, or only high enough and strong enough to control the usual floods which occur every spring, was a source of much vexation, as it was the question of deepest study, to the members of the Commission for many years.

In the report of 1881 they say:

"The Commission is now prepared to recommend as part of a complete system of channel improvement, legislation of the following description. * * * It is proper that this recommendation should be accompanied by the statement that while levees judiciously erected under the system we have indicated *would produce the maximum effect in channel improvement at a minimum of cost*, they would not be of a sufficient height to protect the adjacent lands from overflow during rare floods."

As time passed and their study and knowledge of the floods was widened by experience, the conviction that levees should be high enough to withstand any flood that might come became more fixed.

Witness the report of 1883:

"The act creating the Commission makes it the duty of the Commission to consider the subject of the prevention of destructive floods, and, as bearing upon that matter, there is submitted for information the following summary of the probable extent and cost of such system of levees as would be necessary for that purpose. It may be stated, further, that there are serious practical difficulties in the way of constructing a system of levees no higher than would be necessary for the confinement of ordinary floods, and at the same time protecting them against disastrous injury from the great floods which occur at irregular intervals."

And in the same report General Gilmore, the President of the Commission, adds this statement:

"I concur in the foregoing report of the Commission with the single qualification that the value of levees as a factor in the problem of channel improvement in preventing the wide dispersion of flood waters, is not affirmed in the report in sufficiently positive terms, and with that clearness and prominence to which, in my judgment, it is entitled."

Through all these years this question had stood at the doors of Congress demanding an answer. Once again it was turned away with the wrong one. The advice of General Comstock in the report which followed these great floods should have been heeded:

"Before a system of levees can be planned the question must be decided whether it shall be attempted to confine the greatest floods, or only those somewhat less than the greatest. When it is remembered that the cost of these levees will necessarily be great; that, as they will be high, breaks through them will involve large costs in repairs; that their object is to make possible the safe existence behind them of a large and productive population in the alluvial bottoms they protect; that only the expectation of such a population can justify the large expense involved; that breaks in the levees, when the bottoms are filled up by plantations, would involve enormous loss of property; that the annual height of floods in rivers is now believed to increase as the country they drain is cleared up; in view of all these considerations it seems the wiser plan to face at once a great flood, and to provide for its confinement between levees."

Unfortunately this was not done, and the levees were raised so slowly that they were unable to withstand the recurring floods and were continually destroyed; not as fast as they were being constructed to be sure, but progress was seriously checked, and the unfinished line frequently overtopped and destroyed, thus deferring the day of their completion, adding enormously to the ultimate cost, and entailing frightful and repeated losses throughout the lower valley.

DO LEVEES CAUSE THE BED OF THE RIVER TO FILL?

In 1890 another great flood came down the river and the levees in their uncompleted condition were unable to withstand the pressure and were breached in many places. The disaster from this flood was very great. In addition to the destruction of property, much of the work therefore done on the levees was, of course, swept away. The flood level was much higher this year, although the volume of water in the river was less than it had been in previous extreme floods. This was inevitable, of course, because the water which had formerly been permitted to spread over vast areas bounded only by the hills on either side of the valley was now confined by the levees, and instead of spreading over a valley from 40 to 80 miles wide it was forced to pass between embankments only three to five miles apart. The casual observer noted that as the

levees rose higher the flood elevation was correspondingly higher, and the theory which had been advanced many years before, that the construction of levees would cause the bed of the river to rise, was again brought forward and urged with great persistence. This has always been a very popular, though falacious theory. No one is interested in the gauge when the river is low and therefore no one looks at it or regards it. There is no danger then; but the fact is that the low water level has not been raised as would be the case had the channel filled. If a quart of water is poured into a pint measure it will inevitably overflow, unless the sides of the measure are raised. In that event there will be no overflow, *but the water will stand much higher* in the measure. It will not prove that the bottom of the measure has been raised, however. There is nothing new about this theory, though many of its proponents seem to think so.

A hundred years ago, M. de Prony, a French engineer, traveling through Italy, in some way got the notion into his head that the Po, by reason of the levees along its banks, had **silted up its** bed, and in an essay published on the subject shortly after he returned to France he announced this discovery. This was the beginning of the theory. Lombardini, a noted Italian engineer, after a most elaborate investigation and study of the Po, from its earliest available records, completely and thoroughly exposed and refuted this error. About 1855, or a little later perhaps, the Abbe Huc traveled extensively in China and subsequently wrote a very interesting and entertaining book on his travels. In this book he stated that the Yellow River had, by reason of the construction of levees along its bank, so filled its bed that the bottom of the river was higher than the adjacent country. To this fact he attributed the great disaster of 1853, when that river broke through the levees and made a new channel for itself to the sea. It is remarkable how many people have heard this story of the Yellow River who, of course, never read this pious old father's book. Judge Taylor, of the Mississippi River Commission, in an address delivered in New Orleans a number of years ago said:

"I often wonder how so many people get hold of that idea who have so few others."

To one who has made so thorough an investigation of the subject as Judge Taylor, who has drunk so deep at the Pyerian spring, these theorists no doubt do appear thoroughly stupid. The fact is, however, that many people who are very far from being stupid, and who do have a great many "other ideas," and sensible ideas too, have gotten hold of this one, and curiously enough when once they have gotten it into their heads they hold to it with a tenacity which is as unchangeable as it is inexplicable. It is indeed difficult to understand the psychology of it. There seems to be some subtle and mysterious influence by which it reaches the Ego. It evidently flatters the vanity of men, and in that way insinuates itself into their intellectual favor; but be that as it may, the unfortunate, stubborn fact is that having once heard it, no man ever forgets it, and few who believe it ever abandon the faith. Tell him a hundred things about the Mississippi River and then relate this story; he will forget the hundred facts, but he will not only remember this fallacy; he will take pains to impart it to every other man who will listen to him discourse upon the subject.

General Wilson, of the Army Engineer Corps, visited China and made a visit to the Yellow River to study, if possible, this most unnatural phenomenon. In his book, written upon his return, he devotes some space to the old Abbe's story, but gave it as his opinion that it was wholly inaccurate. He subsequently wrote a letter to General Comstock, who read it to the Rivers and Harbors Committee in the hearings of 1890. General Comstock's statement so illumines this whole subject that it is printed in full elsewhere (p. 221). This hearing (1890) is one of the most interesting and instructive ever had on the engineering problems of the Mississippi, and its perusal is earnestly recommended (see p. 221).

The late Col. Smith S. Leach was universally regarded as one of the greatest engineers ever employed on the work of controlling the floods of the Mississippi River. He was, for twelve years, in active charge of this great work. In an article contributed to the "Manufacturers' Record" many years ago, speaking of this hypothesis (I say hypothesis advisedly because it has never risen to the dignity of theory), he said:

"If any proposition more than another is inconsistent with everything that has been stated in this paper, it is one

which has obtained wide currency, and on which opposition to levee building is largely based, that levees cause deposits in the channel and thereby raise the bed of the river. The votaries of this doctrine ignore the testimony of the Mississippi itself, which is conclusive against them, and depend upon an alleged analogy with the Yellow River of China, about which no one knows anything, and with the Po, of which everything that is known refutes their hypothesis."

The only leveed rivers in the world where the bed has silted up are those rivers which flow from a high elevation down a steep, inclined plain, and suddenly debouche into a level country. These are silted up, not because they are leveed, but in spite of that fact. The Sacramento River in California is a good illustration. In the early days of California (1849), immediately succeeding the discovery of gold, the principal activities of the people were directed towards the mining of gold in the mountains. The process was hydraulic mining, which literally tore the mountains to pieces, and in the course of years washed the debris down the mountain slopes in tremendous quantities. It was discovered, all too late, that this particular method of mining would inevitably destroy the navigable streams. Col. Townsend, in an address delivered at Memphis, Tennessee, September 26, 1912, said, speaking of this contention:

"The assertion is now admitted to be false on the main rivers of all civilized countries which are capable of being studied, but it is still claimed that it is true in China and Japan. I recently visited Japan and had an opportunity to further investigate the subject. On the larger rivers, like the Osaka, there were no evidences of any such action, but in mountain streams which flow down steep hill-sides and suddenly change their slope when they pass through plains, as is the case with a number of streams which empty into Lake Biwa, the upper portions of the streams have been scoured out, forming deep gulleys, and the material thus eroded deposited at the foot of the hills."

This description fits the situation in the case of the Sacramento perfectly. Continuing he stated his opinion:

"My own view of the effect of levees on stream flow is that they tend to remove irregularities and make the slope more uniform. * * * They should also, to a certain extent, *enlarge the river section*, but at a rate so

low that it would be a question of practical importance to those who will inhabit the valley in the twenty-fifth century, rather than those who are tilling it today."

Humphreys and Abbott had investigated this theory fifty years before, had traced its genesis and demonstrated its fallacy. The Commission of Engineers appointed in compliance with the act of June 22, 1874, "to report a permanent plan for the reclamation of the alluvial basin of the Mississippi River" had reported that "This idea is utterly without good foundation either in theory or experience" (H. Ex. Doc. 127, 43rd Cong., 2nd Sess.). Every engineer who has ever been set to work on the question has broken and shattered the old vase, but the scent of the old priest and the French de Prony still cling to the fragments. "I don't know why I love you, but I do," is still the only reply of its votaries. Congress, however, wanted a better answer. If the bottom of the river was filling up as fast as the levees were made higher, of course, it would be a useless and senseless waste of money to continue appropriations for the building of levees, and so the Committee on Rivers and Harbors summoned before them the most expert engineers in the corps, and called upon them for enlightenment and advice on this subject. The hearings were full and the fallacy of the contention clearly, and it was hoped finally, demonstrated (p. 221).

HEARINGS OF 1890. CHANGE IN THE LANGUAGE OF THE BILLS.

The hearings covered a much wider range than this single question. The whole problem of flood control and the levee system was thrashed over. The relation which the levees sustain to the problem of navigation and the broader, though kindred, subject of commerce, was investigated. The question of flood control and the relative duties and responsibility of the States and the nation, all were discussed, argued, and resolved, with the net result that the proviso "that no portion of this appropriation shall be expended to repair or build levees for the purpose of reclaiming lands or preventing injury to lands or private property by overflow," which had been carried in all previous bills *was thereafter omitted*. Three million two hundred thousand dollars was appropriated "for the general improvement of the river, for the building of levees, * * * in such manner as in their opinion shall best promote the interest of commerce and navigation." This was

the bill of Sept. 17, 1890. In the bill of 1892 this language was changed again to read as follows:

"For the general improvement of the river, for the building of levees and for surveys, including the survey from the head of the passes to the head waters of the river in such manner as in their opinion shall best improve navigation *and promote the interests of commerce at all stages of the river.*"

This language has been carried in all succeeding bills.

THE FLOOD OF 1897 AND THE NELSON REPORT.

In 1897 another disastrous flood occurred. Though less in its disastrous effects than its predecessors, it nevertheless destroyed much property and washed away sections of the still uncompleted levees. Following in the wake of every great flood which had deluged the valley in all the years since the jurisdiction and responsibility of the control of the river passed to the Federal Government by the Louisiana Purchase, Congress has ordered some special committee, or created some special commission "to investigate and report." It has never heeded, however, except in a small measure, the advice contained in any of these reports, but universally, for one reason or another, has adhered to the wasteful policy of "piece-meal" appropriations. The result was always the same; the riparian owners could not raise sufficient money to complete the levees to the grade and section fixed by the engineers, Congress would not, and the inevitable happened. The next great flood would wash away a part of the levees, the ultimate cost of a completed system was thereby increased, and the aggregate of property values destroyed grew with each crevasse.

So it happened after the flood of 1897. The Commerce Committee of the Senate was authorized and instructed to examine and report—

First, what are the causes of the disastrous floods in the Mississippi River and its tributaries, and how can such floods be prevented or diminished?

Second, if such floods are the result to any extent of the destruction of timber upon or near the headwaters of said river or its tributaries; what measures should be adopted to prevent such destruction, and whether reservoirs to hold the water caused by rain

or the rapid melting of snow on or near said headwaters should be constructed to prevent the floods caused by the sudden precipitation of the rain or snow water into the streams flowing from the regions where the sources of the Mississippi and its tributaries are located.

Third, whether said reservoirs, if their construction should be deemed necessary for the purposes before set forth, could not also be utilized for the irrigation of arid lands in the vicinity of such reservoirs.

Fourth, whether the outlet system by which it is proposed to furnish avenues through which the waters of the Mississippi River can escape in times of flood is practicable or expedient.

Fifth, whether the present system of improving the Mississippi and Missouri Rivers, under which it is sought to confine the water within the banks of said rivers, by means of levees, and by such levees, together with jetties at different localities, to increase the erosive power of the current so as to protect the banks and deepen the channel, should be continued.

Sixth, what has been the effect upon navigation and commerce of the jetties at the mouth of the Mississippi River, and what is the present condition of said jetties and their probable future?

Seventh, whether the Mississippi and Missouri River commissions should be continued in existence, and, if continued, what amendments should be made to the statutes creating such commission and defining their duties and powers.

Eighth, what legislation is necessary to prevent the enormous destruction of property by floods in the Mississippi River and its tributaries, and what amount of money should be appropriated by Congress for the establishment and maintenance of systematic improvements and safeguards for said purposes?

THE NELSON COMMITTEE'S REPORT.

On the 15th of December, 1898, Mr. Nelson, from the Committee on Commerce, submitted the report of the Committee, which is printed as Senate Report No. 1433, 55th Congress, 3rd Session, making a volume of 518 pages, including maps and hearings. The conclusions reached by this Committee were the same as had been reached by all the other Committees and Commissions which have

been charged with the responsibility of making a thorough investigation of the subject. As to reservoirs the report concludes:

"The scheme is regarded by nearly all engineers and other experts as wholly impracticable; in short, your committee can discover no sure or adequate relief in reservoirs." As to outlets:

"Neither can your committee discover from the evidence or through other sources any material relief from the outlet system."

As to levees:

"From all the evidence taken and considered by your committee, it is evident that the basins and bottoms along the Mississippi river exposed to the floods of the river can only be protected and preserved from such floods by an ample and complete system of levees from Cairo to the head of the passes. Crevasses and inundations, resulting in extensive loss of life and property, are liable to occur during all floods so long as the system is incomplete. The burden of completing the levee system is too great for local and State authority. Your Committee are of the opinion that the Federal Government should continue, as it has since 1882, to aid in the great task of controlling and repressing the floods in the river."

Once again the question which had never been correctly answered was knocking at the door of Congress. Once again the truth was set before Congress: "The burden of completing the levee system is too great for local and State authority," and once more the answer was: Wait!

Referring to the flood of 1897, the Committee reported that "the flood of 1897, wrought great havoc, especially in the older levees, many of which had been defectively and improperly constructed. There were 23 breaks in the St. Francis front, six in the Yazoo front, 14 in the White river front, and four in the Tensas front, most of which occurred from an overtopping of the levees." The loss to the riparian owners was tremendous, but they by no means abandoned hope. Always praying and always believing that Congress would some day take up the burden and make it possible for them to reclaim this vast empire which would add so much to the wealth and welfare of the nation, they continued to struggle beneath a tax load self-imposed, almost, if not quite, unequalled in the history of agricultural activities. The engineers of the Commission had gained much knowledge and collected most valuable data during

the flood of 1897, and having resolved and digested it, they were able to declare in their annual report made to Congress the following winter:

"The important fact that the flood waters of the Mississippi river may be permanently controlled by a system of levees that can be constructed within a limit of expense warranted by the advantages to be gained seems to have been fairly demonstrated by the flood of 1897."

The Sundry Civil bill approved June 4th, 1897, appropriated a little more than two million dollars as an emergency fund and made it immediately available to supplement an equal amount which had been authorized in the Act of June 3, 1896. This gave the Commission approximately five million dollars for levees and other channel work. The contribution by local interests was greater than ever.

FIRST FLOOD PASSES WITHOUT A CREVASSE.

The greatest activity ever witnessed on the levees followed, and the results were most happy. The great breaches which had been made in the levees were closed, the whole line was strengthened, and when the Commission made their report in 1898 they were able to say, after the flood of 1898 had passed down the river:

"This is the first time in the history of the river since the commencement of the continuous levee system that a flood reaching the height of 49.8 on the gauge at Cairo has been carried to the gulf without a single break in the levees."

THE FLOOD OF 1903 AND ITS LESSONS.

For five years the levees successfully held back the floods, but in 1903 another great flood came and the levees were again breached. The work which had been done, however, demonstrated more clearly than ever before that a completed levee system would give immunity from floods to the whole valley. In their report of this flood, the Commission, after discussing it fully in all of its phases, conclude with these words:

"The past flood showed more clearly than has any previous one, both the importance and the practicability of a complete and efficient levee system. In its present

condition, incomplete both as regards extension and dimension, it gave substantial protection to $\frac{3}{4}$ of the alluvial valley and its interests, which under equal flood conditions without levees would have been a lake from 20 to 80 miles wide from Cairo to the gulf. The improvement made during the past six years has reduced the number of crevasses between Cairo and New Orleans from 38 to 6. Of the area overflowed this year $\frac{5}{8}$ was the direct result of the back water from the low lands of the basin and overflow through unbuilt parts of projected lines and only $\frac{3}{8}$ from breaks in the levees, notwithstanding their unfinished condition as regards both grade and section."

Accepting at its face value this assurance of the Commission that "The work which had been done, however, demonstrated more clearly than ever before that a completed levee system would give immunity from floods to the whole valley," the riparian owners redoubled their efforts to hasten the day that would witness this consummation so devoutly to be wished. The years which had elapsed since 1884, when Congress first began to make appropriations to assist in the building of levees had marked a most gratifying industrial development throughout the entire delta. There is no bureau of statistics maintained in the Mississippi Delta, but the Mississippi River Levee Association, which is the official organization and mouthpiece of all the levee districts, has, at great expense of time and labor, compiled some very interesting facts which show how well the people have taken advantage of their opportunities, and demonstrate beyond all cavil what the future development of the valley would be if a complete system of flood protection were assured. It has been shown (p. 24) that as a result of the floods of '82, '83 and '84, not only had all activities and progress in the development of the country been suspended, but that both property and hope had been abandoned. The following figures given for 1880 therefore really overstate the development actually existing in 1884.

INDUSTRIAL DEVELOPMENT IN THE DELTAS.

In 1880 the population of all the deltas was 445,604; in 1910, 829,720. In 1880 there were 1,619,721 acres in cultivation. What a sombre picture that is! Here in the heart of this most marvelously fertile and productive valley, with 16,000,000 acres capable of producing the greatest crops of the world, at the end of a hundred years

of struggle and ceaseless warfare against the great Father of Waters, less than two millions acres had been subjected to the will and purposes of man! In 1910 there were 3,585,070 acres in cultivation. Farm values in 1880 were listed at \$50,961,199; in 1910, \$174,187,559. The value of personal property on these farms in 1880 was \$12,776,012; in 1910, \$50,115,939. In 1880 there were no railroads and never could be; in 1910 there were 3,200 miles of railway. In 1880 there was one banking institution in all this great valley, located at Helena, Ark., and with a capital of \$20,000; in 1910 there were two hundred and forty-six banks with a combined capital and surplus of \$15,600,000 and with deposits of \$43,300,000. These figures give probation more strong than proofs of holy writ that every dollar which had been spent by the Federal Government had been bread cast upon the water and was coming back a thousand-fold in contribution to the wealth of the nation and the promotion of the general welfare. Armed with such proofs, still clinging to the hope which had sprung eternal in their breasts that the day was surely near at hand when Congress would harken to their appeals for real justice and set its strong hand to the task, the citizens of the deltas came to Washington in 1904 for another presentation of the case. Elaborate hearings were had. Men from all parts of the country appeared before the Committee, showing the truly national character of the question. Mr. Chas. S. Fairchild, of New York, ex-Secretary of the Treasury, appeared before the Committee. His statement is too important, too lucid, too convincing to mar by merely quoting an extract. The statement and the cause would both suffer in the abbreviation. It is all too short at any rate. It is therefore reproduced in full at p. 314.

That part of Mr. Caldwell's statement in which he deals with the levee problem in its relation to the race question is most interesting and instructive (see p. 315).

The entire hearing in fact is commended to all who are "seeking after light" with the assurance that its careful study will yield ample returns on the time invested (see p. 305).

These gentlemen, representing vast business enterprises in different parts of the country, appeared before the Committee and urged Congress in the light of the developments of the past twenty years and in view of the urgent recommendations of the Mississippi River Commission, which had then devoted 25 years of study to the

problem, to make the right answer to the question which had so long and with such persistency stood knocking at the door of Congress. Sad to relate, the answer was again deferred.

NINE YEARS OF PEACE AND THEN THE DELUGE.

If Congress had then provided funds requisite to complete the levee line, or rather a sufficient proportion of the funds so needed, because there has never been any request made by the riparian owners that they be relieved of their proper part of the burden, the frightful disasters of 1912 and 1913 so stupendous in their toll of life and property as to shock the sense of the entire nation would have been averted. As it turned out, no such favorable opportunity had ever presented itself for the completion of the work. For nine years after the highwater of 1903 no disastrous flood came down the river. Fortunate as this respite was, blessed as the dwellers in the lower valley were in this almost a decade of peace, their lot was not entirely unalloyed good fortune.

Most unfortunately for them indeed, the conclusion was reached that no further assistance was needed for the upbuilding and strengthening of the levees, and the allotments for that purpose from the funds provided for the Commission by Congress grew fine by degrees and beautifully less. In 1911 only \$130,000 was allotted by the Commission for levee construction out of the appropriation for the river of \$2,000,000.

There was, of course, a rude awakening from this iridescent dream. In 1912 and 1913, three floods in two years came down the river and overwhelmed the valley. The destruction of life and property was, of course, greater than ever before. The Commission reported after the first flood of 1912 that \$41,000,000 in property had been actually destroyed by the flood. The loss in human life can not be measured.

"For who shall put an estimate upon the value of the souls destroyed by the same causes; and who shall gather the tears of the widow and the orphan; the bloody sweat of anguished families, and the griefs for loved ones lost, fortunes broken, and hopes destroyed, and weigh them in the scale, with a pitiful appropriation of money?"

These words are taken from the report of the great River Convention held in Chicago in 1847 to urge upon Congress the needs of the Mississippi Valley. How apt they are!

Congress, aroused by the appalling catastrophe, appropriated four million dollars for the levees, but two million dollars of it was spent in rebuilding levees which had been washed away and all of the money contributed by the levee districts was devoted to the same purpose, while their revenues for another year were anticipated to raise money to be spent in temporary works in an enormously expensive campaign against the flood (see p. 3). Later in that session, in the Sundry Civil bill, another appropriation was made of more than a million dollars to meet the expenses incurred by the War Department in relief work among the sufferers who had been rendered homeless and destitute by the ravages of the frightful and cruel waters. The army officers reported that 272,000 people were furnished food and shelter. These were people whose all had been swept away by the angry floods which had been hurried down upon them from 31 States of the Union. The story of this appalling catastrophe can be found in the report of Major Normoyle, printed as H. R. Doc. 1453, 62nd Congress, 3rd Session.

The people of these deltas had contributed more than \$60,000,000 in taxes towards the construction and maintenance of their levees, an amount far in excess of what was required to construct and maintain a levee line strong enough and high enough to withstand any flood that ever had or ever could have come down the river under natural conditions; but the wonderful and extensive drainage systems which had been constructed throughout the great Middle West by the up-to-date scientific and enterprising farmers, who had built that magnificent civilization, fulfilled in awful verification the prophecy of Ellet:

"The process by which the country above is relieved is that by which the country below is ruined."

WHAT SHALL WE DO?

The enormous development of the great drainage area of the upper valley from 1850 to 1880 has been stated. In round numbers the advance in farm values increased from \$828,000,000 in 1850 to \$5,300,000,000 in 1880, resulting in an increase in the flood volume from 1,475,000 second feet in 1858 to 1,800,000 second feet in 1882. The progress in all the elements of scientific agriculture and farming

operations and enterprise which has kept step with the advancing civilization of that same territory since 1880 is unmatched in the progress of the world in all the tide of time. No one element has been so potential in this development as the "process by which the country above is relieved" of its surplus and surface waters. Now note the figures for 1910, just two years before the last and greatest flood—

Farm values of the eleven States in the upper valley in ~~1800~~ ¹⁸⁸⁰ were \$5,317,880,906. These same farm values in 1910 were \$20,000,000,000. Think of it! Twenty thousand millions! But you cannot think of it. It is too stupendous for comprehension. One can only read, and pronounce, and marvel. Twenty thousand millions! Now note the volume of the flood. In 1882 it was 1,800,000 second-feet. In 1912 it was 2,300,000 second-feet.

We may be pardoned for quoting once more from Ellet's report of 1851:

But in pointing out the direct consequences of the system which now prevails to an extent so alarming—of excluding the water from its ancient reservoirs, and forcing the increased burden down the proper channel of the Mississippi—it is not the design to contend against that policy. It would, indeed, be a hopeless opposition that would array itself against the countless interests, private and public, which urge these measures forward. The progress of this work is irresistible. It has become the adopted policy of Congress, as well as of individual States, and is progressing fearfully through the whole area of the Delta.

When the three floods which came in 1912 and 1913 had written their sad story of wreck and ruin in the lower valley, the Commission was called upon once more "to investigate and report." It did, and the unbroken monotony of a century still holds through its every line:

Levees afford the only practicable means of preventing the damages which might be caused by floods in the lower Mississippi Valley. They have been successfully employed on European rivers, and are the only means of flood protection of large rivers that have been tested, or, if tested, have not failed. To restrain floods like those of 1912 and 1913 will require in the existing levee line about twice the yardage now in place. The estimated cost of such enlargement is \$57,000,000 (p. 9).

It is now proposed to provide this fund so that the levees may be completed to the grade and section which the Commission has fixed, in five years. The local interests which have already contributed \$67,000,000 towards the construction of these levees propose to contribute \$15,000,000 more and are asking that Congress provide the balance of the fund necessary. Will it do it? Or will the same old fatal, wasteful, Fabian policy still be pursued? Once more the old unanswered question stands at the door and knocks: "Shall the lessons of the last flood be forgotten with the burial of its dead?"

The Process by which the Country above is relieved is the process by which the Country below is ruined!

The Mississippi receives the flood waters from thirty-one States, and its drainage basin comprises 41 per cent of the area of the United States!

I have stated and devoted much attention to the fact that the drainage of the States to the North of these deltas had accelerated the flow of the rains which fell upon them, and that in this way had increased the burdens of those who live along the lower reaches of the river. I have not made these statements without authority. In Ellet's report, above referred to, this matter is gone into in great detail. This report is quoted again:

"The area of the Mississippi valley is composed in the main, of wide extended plains and level prairies, on which, in the original condition of the country, there was little or no timber. Over these plains, the water which falls on the untilled soil is obstructed by the wild grass and brushes, and consequently retained upon the flat surface until it is either evaporated, or slowly passes off into the natural depressions, which convey it through similar impediments to the greater channels of discharge.

"But, as population takes possession of the ground, the wild grass is removed and the plough is applied to the drainage. The primitive furrows are so directed as to let off the surface water; and the imperfect drains first opened by the plough are subsequently enlarged and made the channels into which the lateral ditches are led. The success of the crop depends on the perfection of the drainage; and, consequently, one of the first efforts of every provident farmer, on breaking up the sod, is to relieve the surface of his fields of standing water. But the water rapidly dis-

charged from these incipient drains meets with impediments in the choked up streams, is led back by fallen timber, and spreads over the bottom land. To save these narrow strips of bottom land, which generally afford the finest pastures, the industrious farmer promptly removes these obstructions from the channel and lets the water off into the country below.

"This process, though in reality hardly well commenced, is yet progressing over the valley of the Mississippi at the rate of many millions of acres annually. The aim of every proprietor is to drain his own fields, and let the water pass as rapidly as possible into the creeks and rivulets which are provided by nature to convey it away. But the land upon the great tributaries into which this water passes, is equally valuable; and each proprietor there fortifies himself in like manner against the annual and increasing flood. He also drains his fields with a view to the more rapid discharge of the surface water; throws up embankments across the low places to shut out the flood; and if the circumstances of his situation will justify it, levees in his front and confines the swollen water to the actual channel of the stream.

"The immediate consequence of all this is, that the water which, in the original condition of the country, remained upon the surface of the prairies until a portion was evaporated, and a portion absorbed by the earth, to be subsequently given out slowly by the springs, is now hurried along hundreds of thousands of artificial drains into the great rivers which supply the Mississippi."

* * * * *

In the report of the Mississippi River Commission of 1883 (page 2431), General Comstock, among other things, states:

"That the annual height of the floods in the rivers is now believed to increase as the country they drain is cleared up."

In an address delivered by Col. Townsend, Member of the Mississippi River Commission, before the drainage Congress at St. Louis, May 15, 1913, he says:

"The subject of land drainage is intimately associated with that of river improvement. The cultivation of the soil largely increases the amount of sediment entering our streams. The direction of the furrow markedly affects the amount of the rain water that flows from its surface and every ditch or sub-surface drain promotes a more rapid

flow into our rivers during floods and possibly effects their discharge during low water."

The Scientific American is not governmental authority, nor is it edited by a member of the Engineer Corps of the Army. It is, however, the great scientific publication of America, and its editorial expressions must necessarily carry great weight on all technically scientific subjects. Recognizing and endorsing the conclusions expressed by the engineers of the Army who have made this subject the study of a lifetime, in its issue of April 12, 1913, in its leading editorial, this great scientific authority said:

"The floods in the upper watershed of the Ohio, with their tragic accompaniment of suffering and widespread ruin, will have carried with them a large compensation if they prove to this nation that the question of the control of the Mississippi River and its tributaries is broader than any State or community and that it must be faced and mastered by the nation at large.

"If anyone asks why the Federal Government should be urged to take hold of this problem on a national scale, and assume full responsibility for the time and labor and great cost involved in obtaining complete control of the Mississippi River, surely it is sufficient to remind him that the drainage basin of this great river covers forty-one per cent of the total area of the United States."

Table showing how increase in flood volume has followed development of upper valley:

Value of farm property in States between the Missouri and Ohio Rivers.	Volume of flood discharge of Mississippi below Cairo, stated in cubic feet per second.
1850— \$827,577,776	1858—1,475,000
1880— \$5,317,880,906	1882—1,800,000
1910—\$20,000,000,000	1912—2,300,000

SHOULD THE FEDERAL GOVERNMENT BUILD THE LEVEES ON THE MISSISSIPPI RIVER?

Whether Congress should appropriate sufficient money to complete the levee system on the Mississippi River is a question which must be viewed from two angles. First, whether the control of these floods constitutes a problem which ought to be solved either wholly or in part by the Federal Government? Second, whether these levees are in the interest of Interstate Commerce?

Let us address ourselves first to the consideration of the question of flood control. When the people of the United States, through their regularly chosen representatives, assembled in the great National Conventions, which represented the three dominant political parties of the United States in 1912 they expressed their views in platform declarations. The candidates for the Presidency as well as the candidates for Representatives in Congress went before the people standing upon these platforms, and so far as those who were chosen in the elections which followed are concerned, these platform declarations must certainly be persuasive, if not, indeed, conclusive. The Democratic party, which was successful in the election, declared, after referring to the devastating floods which had just passed down the river:

"We hold that the control of the Mississippi River is a national problem. The preservation of the depth of its water for the purpose of navigation, the building of levees to maintain the integrity of its channel, and the prevention of overflow of land and its consequent devastation, resulting in the interruption of Interstate Commerce, the disorganization of the mail service, and the enormous loss of life and property imposes an obligation, which alone can be discharged by the Federal Government."

The Republican platform declared:

"The Mississippi River is the nation's drainage ditch. Its flood waters, gathered from 31 States and the Dominion of Canada, constitute an overpowering force which breaks the levees and pours its torrents over many million acres of the richest land in the Union, stopping mails, impeding Commerce, and causing great loss of life and property.



These floods are national in scope, and the disasters they produce seriously affect the general welfare. The States, unaided, can not cope with this giant problem. Hence, we believe the Federal Government should assume a fair proportion of the burden of its control, so as to prevent the disasters from recurring floods."

The Progressive platform was equally strong. It declared:

"It is a National obligation to develop our rivers and especially the Mississippi, without delay, under a comprehensive plan. Under such a plan the destructive floods of the Mississippi would be controlled and land sufficient to support millions of people will be reclaimed."

In accepting the nomination on the Democratic platform, Mr. Wilson said:

"In the case of the Mississippi River, that great central artery of our trade, it is plain that the Federal Government must build and maintain the levees and keep the great waters in harness for the general use. It is plain, too, that vast sums of money must be spent to develop new waterways where trade will be most served and transportation most readily cheapened by them. Such expenditures are no largess on the part of the Government; they are national investments."

Mr. Taft, a short while before his nomination, in a speech delivered before the National Rivers and Harbors Congress, said:

"I am strongly in favor of expending the whole \$50,000,000 to save that part of the country from floods in a reasonable time and to provide a proper levee system."

Col. Roosevelt, as was well-known, had for a number of years urged the Federal Government to build levees on the Mississippi River for the sole purpose of protecting the alluvial territory from overflow. In fact, no man in public life has spoken more earnestly in favor of this great work than he. "We, the nation," he declared, "must build the levees and build them better and more scientifically than ever before."

In the light of these platform declarations and the unequivocal statements of the three candidates, it is certainly reasonable to believe that this house, chosen at that election, all fighting in that great political battle, and each under the banner of one of these three distinguished gentlemen, will agree to the proposition that the protection of the deltas on the Lower Mississippi from disastrous floods

is a burden which Congress must at least share. While these platform declarations may be properly cited to influence the action of Congress upon the subject, the duty nevertheless devolves upon the proponents of all legislation to do something more. Before favorable action is taken the judgment of Congress should be convinced, while the citation of platform declarations can do no more than persuade its will.

NOT A QUESTION OF RECLAMATION.

It is not a question of reclamation, that is to say, the advocates of Federal Control of these floods are not asking that Congress appropriate any money for the reclamation of these overflowed lands. What the people in the deltas ask for is an opportunity to reclaim these lands themselves. This is clearly stated by Senator Percy in his statement which appears at pages 74 and 75 of the recent hearings.

Abraham Lincoln once declared that "The driving of a pirate from the track of commerce in the broad ocean and the removing of a snag from its more narrow path in the Mississippi River, cannot, I think, be distinguished in principal. Each is done to save life and property, and to use the waterways for the purposes of promoting commerce. The most general object I can think of would be the improvement of the Mississippi River and its tributaries." The people in the Mississippi Deltas are urging Congress to drive this merciless pirate from the track of commerce and prevent his ruthless destruction of their homes and properties in order that they may reclaim these fertile lands, to the end that they may become the homes of millions of American citizens.

Another illustration, to personify the river, was made by Senator Percy when he likened it to the savage indians who prevented the pioneers in all the states in the early days from engaging in, and prosecuting their several pursuits of happiness. "When you drove the indians out of the State of Illinois did the Federal Government by that act convert the State of Illinois into a garden? No. It simply said to the men who had the brawn and grit and courage to go there, that you can go there and make a living for yourselves if you have got the manhood to do it, unmolested by hostile tribes; in like manner these people from the valley of the Mississippi ask for one thing and that is, the opportunity to go there and subdue the wilderness unmolested by the hostile waters that belong to this nation." It is a mistake then to assume that Congress is being asked

to engage in any reclamation work. All that is asked is that Congress regulate the flow of the waters which have been precipitated abnormally and unnaturally upon the lower regions of the river by the reclamation which has been progressing throughout the states above for the past half century. Unless Congress does lend a helping hand these people will never be able to reclaim this vast wilderness and subject it to the uses and purposes of civilization. There is no sort of question as to this. It has been shown (p. 23) that when left to their own resources more than one-half of the land protected, or which could be protected, by the levees was actually taxed out of the possession of the owners who had gone into that wilderness and waged an unequal and at last unsuccessful warfare against this mighty destroyer.

LOCAL CONTRIBUTIONS.

The theory upon which the argument is predicated that the land owners alone should pay the expense of building the levees is that they so greatly enhance the value of the protected land. There are several answers to this argument. In the first place it has been ascertained and declared by the Mississippi River Commission, composed of some of the most eminent engineers in the world, that levees should be constructed along the banks of the river as works in the interest of navigation, without any reference whatever to the protection of alluvial lands from overflow. This point was made perfectly clear by the testimony of the engineers who appeared before the Committee and whose statements are printed in the hearings of 1890. The following colloquy between Senator Gibson and Lieut. Col. Suter of the engineer corps of the army, for many years a member of the Mississippi River Commission, is pertinent at this point.

Senator Gibson: You stated a moment ago, in reply to a question by the chairman that if you were improving the Mississippi River even if it were running through a wilderness, if the country through which it ran were not peopled you would still build levees on the banks?

Lieut. Col. Suter: Yes, sir.

Senator Gibson: Why do you hold that opinion?

Lieut. Col. Suter: Because I consider that the improvement of the stream for navigable purposes without it is impossible."

The situation then, is this: it is impossible to improve the stream

for navigation without levees. This is the government's interest. It is impossible to reclaim the alluvial lands without levees, this is the riparian owners' interest. It may well be insisted, therefore, that the duty of the federal government to build levees which incidentally protect the lands behind them is just as imperative as is the duty of the riparian owner to build the levees which incidentally improve the river in front of them. Their interest in the levees is common the burden of their construction should be common. It is not true, however, that the mere construction of levees causes any such enhancement of land values as is frequently asserted. Driving the pirate from the sea, made commerce possible; driving the indians from the frontiers made the pursuits of the pioneer possible; withholding the floods of the Mississippi River makes the development of the alluvial deltas possible. After the levees are built the wilderness will, no doubt, be swept away by the activities of those who subdue it and transform it into fertile and productive fields, but the great increase in land values will only come as the trees are felled, as the logs and underbrush are removed, as houses are built, as ditches are dug; in short, as the wilderness is transformed into the farm and the home. The fact is developed in the hearings, that there are 16,000,000 acres which can be reclaimed and put into profitable cultivation if the floods of the Mississippi are kept off of it. These are not low marshy swamps, as it is frequently supposed. There are 20,000,000 acres in the deltas which can be protected from overflow by a complete system of levees such as is contemplated. Four million of these can not be reclaimed by levees built along the Mississippi, but 16,000,000 are kept from cultivation by the floods which come down the Mississippi River so frequently as to render them untillable. Three and one-half million of these acres, in round numbers, are now in cultivation; twelve and one-half million would be put in cultivation but for these floods. It is developed in the hearings that these cultivated acres will not now sell for \$50.00 an acre as an average on the market; and that the uncultivated lands which are cut over (as nearly all of them are) are probably worth \$5.00 an acre. It is further shown by the hearings that the average cost of putting an acre of wild land into a high state of cultivation with all the necessary improvements which are required by the present day civilization, is \$50.00 an acre.

UNEARNED INCREMENT.

It is difficult to conceive of any very large expenditure of public funds in the prosecution or the development of any governmental

activity which would not carry with it some especial benefit; some particular advantage to a few which would not be participated in by the average citizen. Take, for instance, the appropriations for the Army and Navy. No one will seriously deny that there are some particular interests in the country which are benefited especially, and far beyond the average citizen by these expenditures. Was a battleship ever constructed, was a public building ever erected, was any river or harbor ever improved by the government, without necessarily and very properly carrying with it some especial advantage? I mean by especial advantage, simply that some particular profit accrued to a few by reason of their employment, their trade, the location of their property, or something of that sort. This so-called unearned increment is always present. But to be more direct, to make the analogy more apt: The public domain was disposed of at the nominal figure of \$1.25 an acre. This was not because anybody believed that to be the real market value of the property, but because Congress knew, as did everybody else, that it was vastly to the advantage and best interest of the government to have the public domain peopled by home builders. If every foot of land in the United States belonged to the Federal Government, it would be infinitely poorer than it is today, as the result of the very wise statesmanship and far-sighted policy which has passed title to the public domain into our private citizens. The nation is strong, the nation is great, the nation is powerful, the nation is rich, as the citizens are prosperous, and enterprising, and happy, and patriotic. The land in the far West, that is what was the far West in those days, was sold by the government for \$1.25 per acre, or pre-empted by the homesteader under our very wise land laws; the great railroads were built by the government, practically, and value given to lands which had none, and to those which had some value was added an increase of many fold. It was not the policy of the government, however, to raise the selling price at which these public lands might be acquired by the citizen. To be more specific—if agricultural lands in Alaska are worth \$1.25 per acre and by the expenditure of millions of dollars in the construction of railroads by the government those lands take on additional value and become in their unimproved condition worth \$5.00 per acre, is it proposed or contemplated that the government should thereupon advance the price from \$1.25 to \$5.00 if settlers desire to acquire them; and if not, is this not a clear donation to the purchaser of \$3.75 per acre? Yet I think there is no man

who would advocate the policy of advancing the price of our public lands to those who wish to enter them and build homes upon them, simply because by reason of some government railroad or some privately owned railroad, or for any other reason, the actual market value of the lands had materially advanced. If by this expenditure of \$3.00 an acre these delta lands can be made habitable and rescued from the jungle and converted into productive farms, what difference is there in principle whether the government has brought about this happy result by the appropriation of \$3.00 an acre for levee construction, and thereby enhanced the value of the lands in private ownership, or when, for any reason public land which is worth \$4.25 an acre is sold to private individuals by the government for \$1.25, \$3.00 less than its real value?

In one instance the government expends \$3.00 which it has collected; in the other instance it fails to collect \$3.00 which it could collect. In both instances the citizen is encouraged to become a home builder.

MAGNITUDE OF THE AREA.

The total area of these alluvial deltas which will be protected is about twenty-five thousand square miles. It is difficult to comprehend the full meaning of big figures without stating their relative significance. Twenty-five thousand square miles is about the combined area of Delaware, Maryland, Connecticut, Rhode Island and Massachusetts; it is larger by one-third than the two states of New Hampshire and Vermont; it is almost as large as the great state of Maine or South Carolina, and in fact larger than West Virginia. It is equal to the combined kingdoms of Belgium and Denmark; larger than Greece and Servia, and about the size of the Netherlands and Switzerland combined. If as an original proposition this great fertile valley, peopled as it is, with our own flesh and blood, men inspired by the same hopes and traditions, and bound together by the teachings of a common history and a common purpose, all looking to "one God, one law, one Element, and one far-off divine event to which the whole creation moves"—if, we repeat, it were possible to buy from some alien sovereign this great estate so peopled, and so blessed by the Giver of all things good, would we hesitate to bring it beneath the beneficent light of our stars?

If Maryland, or Massachusetts, or any other state were threatened by destruction from any source, tidal wave, or what not, and

we could avert that disaster, who would quibble about the cost?

This territory produces a great variety of staple agricultural products; that is to say, agricultural products which form a considerable proportion of our export trade as well as a material part of our internal commerce. It is particularly adapted to the growing of the higher grades of cotton, what is known to the cotton trade as "Bender" cotton. This cotton is grown nowhere else in the world except in the valley of the Nile, from which we imported last year 110,000,000 pounds at a cost of approximately 20 cents per pound. England, Germany, Russia, and in fact nearly all the countries of Europe are spending vast sums in an attempt to acquire and develop cotton producing territory within their colonial possessions. Since England assumed suzerainty over Egypt many million pounds sterling have been voted for the extension of reclamation projects on the Nile. Within the past few months \$15,000,000 have been appropriated by the British Parliament for the purpose of further experimenting in the culture of cotton in the Soudan in the hope of eventually making the English spinner independent of the American cotton grower. Our exports of grain are declining. Some of our statesmen and far-seeing economists believe that within a few decades our exports of food-stuffs will cease.

It is estimated by those who have appeared before the Committee, at the recent hearings, and in whose accuracy and for whose judgment the Committee has greatest respect, that if these twelve and one-half million acres were planted to cotton they could reasonably be depended upon to produce annually some \$700,000,000 of this, the most universally required fabric for the clothing of mankind throughout the world. If we can hold our own in the matter of our foreign commerce, this one item would turn the current of gold to our shores in the balance of trade with the world. It would open an opportunity for a million American farmers to become home builders. It would be the most complete answer; it would furnish the most perfect and tempting counter-call to the alluring invitation which is yearly inducing many thousands of American farmers to answer "the call of the North." Neither Alberta nor Saskatchewan offer fields that are as fertile in a climate that is as inviting. It is estimated by those who have appeared before the Committee, and whose statements are printed in the hearings for the perusal and enlightenment of the House, that if this area, these 16,000,000

acres, were planted to cotton and properly and intelligently, though not intensively, cultivated, they would yield a crop of cotton larger than this country has ever produced.

Mr. Bush, President of the Missouri Pacific and Iron Mountain Railroads, by which token we may know him to be one of the great business geniuses of our country, among other things said:

"Think what an impetus would be given to trade, industry and immigration by such an addition yearly to the wealth of the country to be circulated throughout all the arteries of commerce in the land. This vast sum annually would be an enormous accession to our nation's treasury as against an annual comparatively paltry cost for protection of \$2,400,000, which would be the interest charge at 4 per cent on the \$60,000,000 required to accomplish the work. Cotton consumption is increasing more rapidly than is the supply and if the land available for its growth is limited, it behooves this country to utilize to the fullest extent all such lands within her domain."

SHALL THE DELTAS REVERT TO THE JUNGLE?

The question is not simply "shall the Federal Government build these levees and control these floods, or shall it be done by local interest?" The only question presented is, shall the Federal Government do it, or shall the river be permitted to retake and devote to utter destruction and perpetual devastation this magnificent empire, so worthy the ambition of a prince?

"I do not hesitate to say to this committee, and I have no uncertainty about the correctness of the statement, that if the word went back to the Mississippi valley from this committee that the Federal Government had found this problem either too great, or outside of its scope and had said, 'upon your own efforts, you in the valley must rely for your salvation,' not only would the potential development be destroyed, but that country, over 70 per cent of it, within ten years would revert to the jungle; civilization there would be blotted out, prosperity would be destroyed. This is not a conjecture, we have tried it." So declared Senator Percy to your committee, and no man who knows this great man's character, both as a public servant, as a Senator, as a lawyer in the best sense of that word, as a private citizen in whom are so well mixed the elements that go to make the man, will regard lightly his statement.

Of the 16,000,000 acres, as has been already shown, only 3,500,000 are in cultivation, and these, of course, have produced the revenue

which enabled the levee districts to expend the \$67,000,000 in the construction of levees heretofore. Each district is heavily bonded; interest charges must be met; it is not possible for them to raise more than the \$3,000,000 annually, which it is provided they shall contribute towards the further completion of the system. This amount was not arrived at by hap-hazard guess work. When those most interested in this legislation were conferring through their representatives in the preparation of a bill to be presented to Congress at this session, a careful, diligent and earnest and searching inquiry was made into all their sources of revenue with a view to ascertaining the maximum sum which they could possibly raise.

This extract from the hearings will illumine this point:

Senator Percy: About the expense to which these districts can contribute, about whether their's is a fair burden or not, it is not conjectural at all. The burden proposed is just as great a burden as they can bear. There is not any way they could raise a greater amount by taxation, only with the knowledge that the government was going to take hold of these levees, and with the credit thereby given, will then be able to raise the contribution provided under this bill.

Mr. Humphreys of Mississippi: When we had a conference of all those who were interested and contributed to the drawing of this bill, that, in fact, was exactly what we discussed, when we determined how much contribution to ask, was it not?

Mr. Percy: Absolutely.

Mr. Humphreys of Mississippi: How much can we squeeze out of these districts?

Mr. Percy: And the only criticism that is heard along the Mississippi river to the bill from some quarters is, that if it passes, what good will it do us? We will never be able to raise our pro rata.

Mr. Taylor: Is this pro rata about on the lines of the familiar term which the railroads use, "What the traffic will bear?"

Mr. Percy: Just what the traffic will bear, just what the weary tax payer can put up."

If the policy of watchful waiting which has heretofore characterized Congressional treatment of this subject is to be further pursued, the ability of local interests to contribute their proper, or rather their required, proportion will be lessened. Every flood that breaks the uncompleted levee line works frightful havoc, and

these levee districts which are to be our allies in this great work will be less and less able to furnish their share of the sinews of war as these floods recur. The destruction of property, according to the hearings and the official reports of the Mississippi River Commission, by the floods of 1912 and 1913, reached the appalling total of \$50,000,000. As the levees grow higher, as they must grow, and the population increases, as it must increase, every return of these recurring disasters will be marked by an increasingly heavy toll both of property and of life.

Speaking of the necessity for systematic co-operation under the command of a single board and noting the utter failure of the unaided fight against the "personified enemy," the Warren report of 1875 stated that, "The river has no respect for State boundaries and deluges Arkansas through breaks in the levees of Missouri, and overflows Louisiana by floods passing across the Arkansas line." How difficult it is to find words which more clearly set out the truly national character of the problem.

BURDEN BORNE BY THE POOR PEOPLE.

It is suggested sometimes that the planters owning these valuable plantations are the ones who make the profits off of the protected lands and the ones who suffer the losses, and that it is not the business of the Federal Government to spend the people's money to guarantee or insure those who are thus engaged, against loss. As a matter of fact these large planters are by no means the only ones whose losses make up the enormous totals heretofore suggested. There are many thousand small farmers who do not own their land, but who have, by dint of hard work and industry and frugality, accumulated the necessary equipment in farming implements, teams, live stock, etc., whose loss is relatively very much greater than the loss suffered by the land owners. Hon. Jno. M. Parker of New Orleans in a statement before the Commerce Committee of the Senate in 1912 related that on his plantation 96 mules were drowned in a single crevasse, most of them belonging to tenants on his property. One man owned six mules with the proportionate number of cows and other live stock, and farming equipment and he lost everything; all the savings of a life-time were swept away by the rushing waters through a single crevasse within a few hours after the break. This is not an exception but a type. These people pay their proportionate part of taxes; they have, as stated before, already contributed more money than was necessary to build and

maintain a levee line high enough and strong enough to have withstood any flood that ever would come down the river, but for the marvelous development of the great drainage area to the North of them, 31 states and 41 per cent of the drainage of the United States. They built their levees strong enough, but the increased volume of water gathered hastily by virtue of the improved drainage systems in these great states to the North, was precipitated upon them with such fury that it tore down the banks of the river upon which the levees are constructed and tumbled them into the flood. It is the testimony of the army engineers that a large part of the money spent by the states in the construction of levees would have been saved but for this caving caused by the accelerated currents of the river. To be exact, I quote the statement of Col. Leach:

"I may say, generally, with regard to the history of the levee system, that over three-fourths probably, of the entire sum of money expended by the states in the last ten or fifteen years in the construction of levees would have been saved if the United States had prevented the banks from caving."

These people have done all that could be, and very much more than should have been, required of them. Mr. Bush in his remarks before the Committee paid the following very eloquent tribute to the people of the lower valley:

"In song and story have been told the deeds of men who caused the Great American Desert to flee before them and become a vagabond and fugitive on the face of the earth, but their deeds are no more heroic, their accomplishments no greater than the valiant people of the south-land who, undismayed by what seemed to be unsurmountable difficulties, have pressed ever onward in their efforts to save those lands from the ravages of the Mississippi River. They have conducted a national campaign, they have performed their part well, but this great nation of ours ought not longer hesitate but hasten to their rescue and do the governmental work, which, under the constitution of the country, devolves upon it."

THE SECOND INQUIRY IS WHETHER THESE LEVEES ARE IN THE INTEREST OF INTERSTATE COMMERCE.

The Supreme Court of the United States (18 Howard, 421), declared that "The power of Congress to regulate Commerce includes the regulation of *intercourse* and *navigation*."

Let us inquire first into the relation which levees and revetments sustain to the question of navigation.

LEVEES AS AN AID TO NAVIGATION.

Bernard and Totten in their report on the Mississippi River advising the construction of levees solely in the interest of navigation, and with no reference whatever to the protection of the delta lands from overflow, said in 1822 (H. Doc., Vol. 3, No. 35, p. 22; 17th Cong., 2nd Session):

"We shall close this report by pointing out another species of hazard which such boats as are not easily and promptly managed must encounter.

"At the time of high water, currents of excessive velocity set directly from the river over the banks, towards the interior; if a boat gets within the draught of one of these currents, it is only with great effort and labor that it can hope to regain the channel; they are often drawn in by them, and dashed to pieces against the first obstacle. Dyking the river along its banks can only prevent these lateral currents, and time alone can produce this result."

Captain Kingman relates an instance which corroborates this statement of Bernard and Totten as late as 1890 (p. 78).

The improvement of the Lower Mississippi which has absorbed the appropriations made by Congress since the creation of the Mississippi River Commission are of a double character. A part of the money has been spent in the construction of levees, which the Commission in their report of 1882 declared, when judiciously erected under the system recommended by them "would produce a maximum effect in channel improvement at a minimum of cost."

Prof. Henry Mitchell, a member of the Commission, in a separate report said:

"The levee is a useful auxiliary to channel improvement even as now located, and if relocated with due regard to the

special office of river improvement would be of decided benefit."

Again, in their report of 1884, the Commission said:

"We therefore conclude that levees, such as have been herein described, are, in connection with an equalization of width and the prevention of caving, an important part of any general and systematic plan for the improvement of the navigation and the prevention of destructive floods."

One of the best illustrations of the effect of levees in improving the navigable depth of the river is at what is called Plum Point Reach above Memphis. The following extract from a statement by Col. Leach, of the United States Corps of Engineers, explains this very clearly:

"The commission in carrying out the work in the early years at Plum Point had not provided for any levees. In a debate in the Senate on one of the river and harbor bills the point was made by a Senator that the Commission was professing to make an experimental application of their system at Plum Point reach, and a part of their plan was a levee. That year an allotment was made and a levee built on the Tennessee side of the reach. The next year an allotment was made for levees on the Arkansas side and those levees were built. A party was engaged all the time in making surveys. The surveys made after the construction of the second line of levees and before the first flood, and again after the first flood, showed that the high bars in the regulated or deepened channel of about 3,500 feet width had had their tops scalped off 8 feet uniformly. Nothing of the kind had ever occurred before, and in the two crossings under control and under improvement the maximum depths had increased in one case 1 foot and in another case 2 feet, and they have remained to this time."

The following statement of Lieut. Col. Suter, a part of which has already been quoted elsewhere, is to the same effect:

"Senator Gibson. You stated a moment ago, in reply to a question by the chairman, that if you were improving the Mississippi River, even if it were running through a wilderness, if the country through which it ran was not peopled you would still build levees on the banks.

Lieut. Col. Suter. Yes, sir.

Senator Gibson. Why do you hold that opinion?

Lieut. Col. Suter. Because I consider that the improve-

ment of the stream for navigable purposes without it is impossible.

The Chairman. Why?

Lieut. Col. Suter. I think you have got to retain control over the whole volume of water. The discharge which passes within the banks is less than half of the flood discharge of the river, and the low-water discharge is only about one-tenth of that which passes within the banks, about one-twentieth of the total discharge, and any works that you can put in to control the low-water flow on a stream like the Mississippi are liable to be utterly destroyed and rendered nugatory by this vastly larger volume of water which passes down the river during flood stages. At this season of the year the cut-offs occur, which will upset any plan of improvement, because they change entirely the regimen of the river, its course, its slopes, and everything about it.

Again, the water, being over the works and everything else, has a chance to develop new channels precisely where you do not want them to occur. A still further effect is produced where the levees are down; the water that goes over the banks keeps going out and coming back again. Whenever it makes its appearance in the river it acts like a tributary. It produces entirely new phases, just as any tributary will. Sometimes it entirely reverses the conditions of flow. The influence that levees exert under these heads I believe I have stated as conservative. They prevent the river from doing damage to the works we put in to improve the low water discharge of the stream.

The Chairman. If there was no question about protecting the land, and you were simply improving the Mississippi River for navigation would you have built the levees that are now built?

Lieut. Col. Suter. Yes, sir."

This opinion of Col. Suter was distinctly concurred in by the present Chief of Engineers, General Kingman, who at the time held the rank of Captain.

The record of the hearings of 1890 is quoted:

"The Chairman. Suppose you drop all considerations of overflows and regard navigation alone, how then?

Captain Kingman. I should consider that the levee is a very important means of improving navigation, and I can give an instance. The Morganza crevasse was caused by a break that occurred in 1874. It remained open as a crevasse practically until closed in the winter of 1886 and

1887, a period of about twelve years. It has a deep bend there and plenty of water, and there had been no trouble with the navigation until after the crevasse was formed. After the crevasse occurred the navigation became worse and worse, and steamboat men told me they hated to run that bend at night, particularly in low water, when the water was running out. When the water was running out there would seem to be danger of being drawn into the crevasse."

Such was the danger to navigation in times of flood which would be eliminated by the construction and maintenance of the levee line.

Continuing he illustrated how another danger to navigation in times of low water was also obviated by the maintenance of the levee.

"The steamboat men dreaded it at low water because the sand bar, or tongue of land opposite this bend, had extended so far over into the bend that there was hardly room enough for two large steamboats to pass there. The crevasse was closed, jointly by the Commission and by the State, in the winter of 1886 and 1887. Since then the navigation has steadily improved until now it is as good as it ever was. The current is quite regular. There is ample room now, and steamboat men have spoken to me repeatedly this year about the great improvement which has taken place in Morganza Bend since the crevasse has been closed. There is an actual case where the building of a levee made bad navigation good."

With these citations taken from the best informed sources of information in the world I would feel justified were I to conclude here with *quod erat demonstrandum*. But I shall add just one more.

C. H. West, one of the ablest engineers connected with the improvement of the Mississippi River and at present one of the civilian members of the Mississippi River Commission recently said:

"My own conclusions, after many years of careful study and observation, are, that a levee system is a useful auxiliary to channel improvement, but the full effect in that direction cannot be expected until after the system has been made continuous and the embankments of sufficient height and strength to confine the highest floods.

* * * * *

With revetment to stop caving and give fixation to the river banks and the levee system that will confine the floods, there would soon follow a deepening of the bed of

the river and in consequence of its greater carrying capacity a lowering of the flood plain itself could be expected; the final result being deep water navigation throughout the entire year as well as secure protection of the valley on either side of the river from floods."

These are statements of engineers, both civil and military who have devoted many years to the study of the problems presented by the Mississippi River and no layman will arrogate to himself assurance to gainsay their conclusions. The most expensive feature of the project for the improvement of the Mississippi is the revetment of the caving banks.

When the Mississippi River Commission began its work there were many places on the river below Cairo where the depth was three feet and less. These serious obstructions to the proper navigation of the river had been a menace to its commerce from the earliest date. The greatest danger to navigation occasioned by these bars is caused by snags which are arrested in their progress down the river and held in place by these bars.

The Secretary of the Treasury many years ago reported that from 1833 to 1838, forty steamboats were snagged and sunk on the Mississippi River, whose value was placed at \$640,000. This loss increased annually.

Mr. Calhoun, in 1846, in his report to the Senate, heretofore quoted (p. 31), said:

"The annual aggregate loss of boats navigating the Mississippi and its waters at the present time is 107 from all causes. The total loss annually \$2,000,000. In addition the loss of life occasioned by sinking boats was very great."

Reference has heretofore been made to a National Convention held in the City of Chicago in 1847 to consider the Commerce and Navigation of the Valley of the Mississippi. The delegates from the City of St. Louis prepared a most interesting and instructive report which was printed as a part of the proceedings of that convention. Referring to "this fat and fertile valley" of the Mississippi, its extent and certain development was set forth most graphically. "The Creator of the universe," the report continues, "has nowhere on the face of the earth spread more lavishly the means of human prosperity, or stamped more legibly the lineaments of beautiful and convenient adaptation to the wants and necessities of mankind. Visit

it not with the evils of bad government; obstruct not the hand of improvement within it; stay not the tide of population pouring in upon its bosom; and let its broad acres receive that proportion of population which vexes the soil of the Kingdom of Great Britain, and the Bountiful Giver of this great and good gift, will smile from Heaven upon a happy family of more than 275,000,000 of human beings."

Referring to snags and bars, the report continues:

"These obstructions are the heaviest draw-backs upon the Commerce of the Mississippi valley, inflicting annually an extensive destruction of the boats and cargoes and a frightful loss of human life."

The conditions set out so graphically and in such detail in this early report continued to handicap the commerce of the river in an increasing measure as the tide of immigration and the development of the valley proceeded.

With the advent of railroads which paralleled the river and the handicaps to navigation above described adding to the dangers of commerce on the river, it is no wonder that the steamboats gradually disappeared, or that the tonnage borne on the river grew gradually and annually less. In 1912 it is given as something more than 4,000,000 tons. The Mississippi River Commission, upon its creation, at once set about to devise a means by which these sand bars could be removed and the channel of the river so deepened as to give "ease and safety to the navigation thereof." As quoted above the experiment of building levees on both sides of the river so as to confine its flood waters to the channel had proven entirely successful at Plum Point reach, but as the floods thus confined rose higher and increased in volume the banks of the river were eroded and the levees thus constructed were tumbled into the river.

CAVING BANKS.

The extent of this caving almost passes belief. The annual amount of the earth thus caved into the river is sufficient, if it could be so congested, to fill the river to the top of its banks for a distance of 30 miles. Mr. C. H. West, a few years ago in his report to the Lower Yazoo District, of which he was Chief Engineer at that time, stated that of 189 miles, which was the length of his levee line, 172 miles—about 90 per cent—had been abandoned on account of caving banks, within 25 years. The effect of this caving is most disastrous

to the proper regimen of the channel. This erosion takes place habitually along the concave banks in the bends of the river, and is deposited a few miles below, thus forming the bars which had proven so destructive to the commerce as heretofore related. This same condition obtained along the reaches of the Missouri River and to such an extent that steamboat traffic was literally driven off of that river.

BANK REVETMENT.

The Commission set about then to devise some means by which this erosion could be prevented and within such limits of cost as would be reasonably economical. The plan adopted has proven absolutely successful. Willow mattresses are woven together and held by wires and sunk below the low water level so that they cover snugly the bank of the river for two or three hundred feet from the low water level out toward the center of the stream.

A very full discussion of the efficacy of levees in improving the channel depths of the river appears in the report of the Mississippi River Commission for 1893, by General Comstock, Col. Suter and Prof. Whiting, and in the report of Lieut. Col. Amos Stickney in the report of the Commission for 1896. The last mentioned report states that the building of levees without bank protection may be considered as only temporary work, and further, that nearly every yard of these costly structures would sooner or later have to be rebuilt if the river were permitted to wander back and forth in its valley, annually carrying off hundreds of acres of land; tearing down levees and filling up its old bed, thus continually adding to the obstructions to navigation and impeding the flow of floods.

In 1908 the Mississippi River Commission in their annual report, state:

"There is another consideration, not of the greatest weight, perhaps, but one which, in the opinion of the Commission, is worthy to be taken into account. It appears to be highly probable that before very many years the Government will undertake the development of a channel for navigation in the Mississippi River below Cairo of much greater depth than has been so far attempted. The river bed is now in favorable condition for such an improvement. But if the revetments which have been enumerated should be abandoned, or not effectively maintained, or others equally important should be omitted or neglected, and the river should be permitted to have its way in tearing down

banks and building bars for a few years, changes will take place which can never be undone and which will greatly increase the difficulty and expense of securing a deep channel. It is a case in which an ounce of prevention will be worth pounds of cure."

This statement had reference to the agitation which was very general at that time throughout the Mississippi Valley for a 14-foot channel from Chicago to the Gulf.

Lyman E. Cooley, a civil engineer of great reputation, in a most interesting and elaborate discussion of the project for this 14-foot water way before the Senate Committee on Commerce in 1910, speaking of that section of the river South of Cairo said:

"The distance for practical consideration in the improvement of the stream is the 750 miles between Cairo and Red River. In that distance it is estimated that approximately a billion yards of material is cut from the banks every year, or in the average year. That is equivalent to saying that a strip 500 miles long, 100 feet wide and 100 feet deep, the depth from the top of the banks to the bottom of the pools, is cut from the banks of that river each year, amounting to a billion yards."

Illustrating the disastrous effect of this caving on the channel of the river, he added:

"Take a bend that cuts for a length of five miles and for a width of 100 feet and to the depth of the pool, 100 feet, this will give 10,000,000 yards. That is a characteristic of currents. Ten million yards is a square mile 10 feet deep. This material is largely deposited in the first crossing below, and will fill it up to a depth of 10 feet for perhaps one or two miles, a part of it going to some farther crossing. As the river falls it must find a new channel through that deposit. It may duplicate the channel of last year or it may be directed by hydraulic dredging, and again it may cut out erratically and change the conditions below, diminishing in effect down the stream. Now, hold the banks of this bend. You stop this local deposit. You have an immediate effect on the crossing and the benefits are felt downstream 15 or 25 miles. As you hold other bends the effect is increased until the whole stream is under control."

Referring to the possibility of securing this 14-foot depth, Mr. Cooley further said:

"You can see at once, as any one can understand, that if you stop the local erosion of a billion yards, amounting to two and a half times all the material that comes to the river, two and a half times all the material that goes out of it, that when you have stopped that, by securing these banks, you have changed radically the nature of the stream. Exactly what effect will be produced I cannot say. There will be some lowering of the river bed; the horizon of the bars will be greatly reduced. I have no doubt it will produce 14 feet the year around.

Senator Burton. That work alone?

Mr. Cooley. Yes, sir; and that it will improve with time."

FOURTEEN FEET THROUGH THE VALLEY.

He gives it as his opinion in fact, that revetment would give a deeper channel than 14 feet and that if it were ever expected to have a ship channel from the Gulf to Cairo, that it would be necessary in order to secure it, to complete the work of revetment now in progress on the river. I quote from his statement once more:

"Senator Nelson. Will you tell us how you would proceed to get a 24-foot channel from the mouth of the Illinois down to the Red River? I take it that there is a 24-foot channel from the mouth of the Red River to the head (of passes) at all seasons.

Mr. Cooley. I will answer that question in this way. It is agreed, gentlemen, I do not think there is any dispute about it, that the effect of holding the banks will be to produce not less than 14 feet through the lower Mississippi. It is believed by some high officials, and has been so expressed to me, that it will probably result in at least 20 feet, and I wish to say that if it does result in 20 feet you will have 24 feet for eight or ten months."

There is no man who has ever been connected in any way with the improvement of this river whose judgment in all matters touching the various methods for its improvement, its effect upon the commerce of the river, or the desirability of the prosecution of the project in the interest of navigation as well as flood control, is entitled to more consideration, or whose opinion should carry greater weight than the opinion of Judge R. S. Taylor of Indiana. Judge Taylor was appointed by President Harrison as his successor when he left the Commission to become President of the United States, and since that time he has devoted to it the greater part of his time, and brought to its study all the energy and power of his great in-

telleet. No man is ever listened to with greater interest or more perfect confidence and reliance by both the Committee on Commerce in the Senate and the Rivers and Harbors Committee of the House. He has never addressed either of these Committees without instructing them, and has never discussed any phase of the great problem presented without illuminating it. The following quotations from his statement before the Commerce Committee of the Senate in 1910 explain very clearly the work of revetment and demonstrate its necessity if the channel of the river is to be kept at a depth which will certainly be required if it is ever to be a real highway for our commerce:

"I have spoken so far of revetments as means of preventing cut-offs and protecting levees, but if we are to look forward to the development and maintenance of a deep channel down the Mississippi River, whether it be 14 feet or less or more, then revetment assumes importance for another and entirely different purpose. The only impediment to navigation in the Mississippi River is the bars. These bars come almost entirely from the caving banks. There is some sediment coming into the Mississippi River at Cairo from the Missouri, but it is a comparatively small portion. Altogether the greater part of the sand which builds up the bars comes from the banks in the vicinity."

"I have sometimes been asked the question, very frequently, in fact, whether the improvement of the lower Mississippi to a 14-foot depth is practicable. I answer without hesitation that it is."

"Every revetment that is put in and holds its place stops that much caving and cuts off that much of the supply upon which the bars are fed. If the caving banks were all revetted the bars would be starved out; they would not disappear entirely, but they would be reduced to such small proportions that you would have a deep natural channel. I believe that if the banks were all revetted the river would become navigable to 14 feet without any other sort of an improvement at all. If we have in mind the probability of looking for further depths in the Mississippi River, the course we want to pursue is to greatly increase the number of revetments, with the view of diminishing the activity of bar building. It is certainly true that the revetment of caving banks diminishes the activity of bar building. There is a stretch of river called Plum Point reach, about 75 miles above Memphis, where a large number of revetments were put in years ago and a large number

of them are there yet. For 40 or 50 miles below that reach there has been a noticeable diminution of bars. They are of less height than they once were, and I think the evidence is clear that they have shrunk in consequence of the revetments that have been put in above them: and there is nothing to account for it that I know of except the diminution of bar building activity due to the revetments in Plum Point reach.

If we ever expect to greatly increase the depth in the Mississippi River below Cairo, revetments will be necessary. Nothing can be more certain than that; and inasmuch as every revetment that is put in now to protect the levee at a critical point will contribute at once to the diminution of bar building activity and also to protect the levee and so do service in two directions at once, I say, gentlemen, that I know of no place in all the United States where you can put \$4,000,000 with more certainty of useful results than right there."

"Senator Burton. What share of the sand bar building material, as you term it, in the river below Cairo originates from the caving of the banks, and what share comes in from above? You never made any calculation on that I suppose, but your statement gives less importance to that which flows in from above Cairo than some have given to it.

Mr. Taylor. I know it does, but I think I am right there.

Senator Burton. Now, reducing it to fractions, approximately, what would you say it was from the Mississippi River above Cairo and what share developed in that section?

Mr. Taylor. I should say, without any hesitation, although you must know that this is largely conjecture, yet I should say without hesitation, that not 1 per cent of it comes from above Cairo."

THE HYDRAULIC DREDGE AND ITS LIMITATIONS.

He then discusses the hydraulic dredge and its operation, with the final conclusion that no permanent or dependable channel can now be maintained by this agency:

Senator Burton. You do not think you would get 5 additional feet by dredging? You have 9 now.

Mr. Taylor. No, sir. I do not think you could get 5 additional feet by dredging. We tried two experiments: one last year and one the year before. We experimented on two or three bars to see if we could get 14 feet by dredging.

We made a success on two of them and a failure on the third. The result of the experiment as a whole was to indicate that an attempt to get 14 feet by dredging in the present condition of the river would be uncertain and unreliable.

Senator Burton. To increase the depth by spur dikes or by contracting the width of the channel would be a very different question.

Mr. Taylor. You could not do that.

Senator Burton. Or by dams or anything of that kind?

Mr. Taylor. I do not think so."

PERMANENCY OF REVETMENT WORK.

The following description of revetment work and its durability is taken from the statement of Mr. S. Waters Fox, made before the Senate Committee on Commerce in 1910. Mr. Fox is a civil engineer, but was employed by the government for 24 years in work on the Missouri River. It will be observed from his statement that revetments, when once properly placed, will last forever:

"Mr. Fox. The revetment work on the river was the result of a good deal of experimentation by the Government, and finally, resulted in what is known as the 'continuous woven willow type.' It consisted of a mattress made of willows, woven in basket form into a continuous piece that was about 80 feet wide from the standard low-water contour of the bank and extended from end to end of the bank to be protected. This mattress was reinforced by a system of galvanized steel-wire strands and anchored to the bank by means of those wire strands to deadmen back of the top of the bank. The bank from standard low-water contour, or the inner edge of the mattress, as nearly as the stage of the water permitted, was graded to a slope that varied from two to three on one, or, even flatter in some localities, by means of an hydraulic jet. The mattress was sunk in contact with the bottom by means of riprap stone, and the upper bank, from the inner edge of the mattress to a contour about $2\frac{1}{2}$ feet above standard high water plane, was protected by means of a pavement of riprap stone. This pavement was covered over with spawls that would fill the interstices of the pavement.

Senator Martin. How long do those mattresses last?

Mr. Fox. Indefinitely, if not outflanked by the river or torn by abrasion from ice.

Senator Martin. Would they not rot out or decay?

Mr. Fox. No, sir; because, in the later construction,

when the revetment became standardized to the specifications I have just given the inner edge was kept down near the standard low water contour, and that provided for all but a very narrow strip of the mattress being constantly under water, and all of it was under water for a long enough period to thoroughly leach out those acids that tend to decay the brush, so that in a short time the brush forming the mattress was robbed of its rotting qualities and was indefinitely preserved.

Senator Martin. What length of time by actual experience have you observed those mattresses, and how long have they been constructed—what length of time for observation have you had?

Mr. Fox. Since 1879.

Senator Martin. About thirty years?

Mr. Fox. About thirty-one years; yes, sir.

Senator Martin. And there is no indication of decay or decomposition at all in those thirty-one years?

Mr. Fox. The standard construction of which I speak was not adopted until some time after that, but of the earlier structures which were put under water, we have a good many examples which prove that brush mattresses below a constantly wet horizon do not decay.

Senator Martin. Some of the parts are under water and some are not?

Mr. Fox. Those parts of mattresses that in the early constructions were well above midstage rotted out sooner or later; more quickly if the brush had been cut during the period of active growth than when cut late in the fall or winter.

Senator Martin. What was the result to the balance, did it not give way?

Mr. Fox. In the earliest constructions; yes. But later on the anchorage held the lower work in place, and the danger was confined to the upper bank work.

Senator Martin. Do you not have to renew the part of it that rots out for the protection of the part that is under water?

Mr. Fox. In the later construction, when revetment became standardized, the specifications were such that no part of the work was of a perishable character. It was all of a permanent character, with stone on the upper bank and brush on the sub-bank.

Senator Martin. So that as now constructed you would consider them imperishable?

Mr. Fox. I would consider it practically so; as much so as any work of man is.

Senator Martin. As much so as stone or iron?

Mr. Fox. It is made of stone where exposed.

Senator Martin. I thought it was made of brush.

Mr. Fox. The brush is under the water. And there it is not perishable. We have taken out of the river pieces of wood from hulls and trunks of trees that must have been there a great many years. I remember in excavating for a new mouth of the Osage River we found in the bottom of the cut which was below the line of permanent saturation black walnut trees over which there were growing white oak trees that must have been 600 years old. Those trees were in a perfect state of preservation; they were absolutely sound."

These opinions of the engineers who have spent so many years the study of the river and its serious problems are quoted for the purpose of demonstrating beyond all peradventure that revetment work is an absolute essential to the improvement of the river solely in the interest of Commerce and Navigation. It is exactly the same character of work that is being done and has been done on the Missouri River from Kansas City down, and which must be and inevitably will be done on the reaches of that river above Kansas City to Sioux City. It is absolutely necessary in order to maintain a 9-foot channel below Cairo. We are now prosecuting a project for 9 feet in the Ohio River from Pittsburgh to the Mississippi River which will cost upwards of \$65,000,000.

We are engaged on a project on the Missouri which will secure similar depth from Kansas City down stream and it would be nothing short of monumental stupidity aside from a wicked waste of the people's money to complete these two great projects and then abandon the main stream into which they flow and over which their commerce must pass in order to reach the Gulf.

From the above statements it is very clear, and will be apparent to anyone who reflects upon the subject, that it is utterly unfair to charge the cost of this revetment work on the lower Mississippi against the project for the completion of the levee system, or to state that it is being done for the protection of those who live in the deltas of the lower river.

RIVER TRANSPORTATION AND RAILROAD RATES.

The decline in the tonnage borne on the lower Mississippi has been noted and its causes stated. But it must be remembered that navigation is only one of the elements embraced in the broader

term commerce. It means something more. It is a mistake, therefore, to value the function which a river performs as a great transportation agency solely by the amount of freight which actually floats upon its bosom. The fact that the river is capable of bearing tonnage is a most material factor in regulating and reducing railroad rates. It is no answer to this, that the Interstate Commerce Commission and the various railroad Commissions in the states are created and maintained at great expense and clothed with full authority and power to compel the railroads to charge only reasonable rates. There never has been and there never will be any governmental authority created which can ascertain as well or as accurately as these companies can themselves, just what the minimum profitable rate is. If a reduction in a given rate is proposed by the Interstate Commerce Commission, the railroad companies at once take the position that the rate is confiscatory and the Commission must institute a most searching inquiry into all the related subjects and functions of the road to ascertain whether the proposed reduction will in fact leave a rate sufficiently high to be reasonable. If, however, this same road is forced into competition by the improvement of a competing waterway their rates will at once voluntarily be reduced, frequently to a point lower than any commission could ever justify if it prescribed the reduction.

In his testimony before the Commerce Committee of the Senate, when the railroad rate bill was being considered, Mr. Stuyvesant Fish, President of the Illinois Central and Yazoo and Mississippi Valley Railroads, said:

"The rivers, and especially the Mississippi River, control rates and will continue to do so even though the steamboat traffic shall not be renewed."

In his testimony before the Nelson Committee in 1897, Mr. Chas. A. Pillsbury, the great flour mill man of Minneapolis, said:

"We consider the presence of the Mississippi River and the fact that it is kept in a navigable condition the great regulator of the railroad rates; that the benefits should not be measured by the tonnage as much as by the possibility of sending the freight by water."

Upon further questioning he stated that much of the flour milled at Minneapolis would actually be transported to the sea on the Mis-

Mississippi River but for the fact that railroads on account of this competition gave him such very low rates.

The annual products of the Mississippi Valley amount in value to \$15,000,000,000; a sum entirely beyond the comprehension of the normal mind. Of this amount about one-half is the value of farm products. Every dollar of this incomprehensible total is affected by the transportation rates by which the surplus can be delivered to the consuming markets, and this total is increasing annually by leaps and bounds.

As stated in Mr. Austin's article on the Panama Canal, 85 per cent of the corn; 75 per cent of the wheat; 70 per cent of the live stock; 70 per cent of the cotton; 70 per cent of the iron ore; 70 per cent of the petroleum; 50 per cent of the wool; 50 per cent of the copper; 50 per cent of the lumber; 50 per cent of the coal and 40 per cent of the manufactures of the entire country are produced in the Mississippi Valley. Since 1870 the production of corn in the United States has increased from a billion to three billion bushels per annum; wheat from 235 million to 650 million bushels per annum; cotton from three million to fifteen million bales; farm products from \$2,000,000,000 to \$9,000,000,000 per annum. The growth in our manufacturers has kept this pace, having increased from \$4,250,000,000 in 1870 to \$20,000,000,000 in 1910. From these figures it is perfectly apparent that any legislation which will enable the people of this busy valley to transport their products at a lesser rate than is charged today will effect a very material reduction in this character of taxation.

Mr. H. G. Wilson made a most interesting statement before the Rivers and Harbors Committee in which he went into great detail in his explanation of this particular subject. He was, for many years, an official in the freight traffic department of the Kansas City, Fort Scott & Memphis Railroad and is one of the best-posted men who has appeared before the Committee on Rivers and Harbors. He stated that railroad rates from the territory lying East of Pittsburgh and Buffalo to points as far West as Galena, Kansas, and Denver, Colorado, were all affected by the water transportation of the Mississippi River; and that the rates on all the traffic across Missouri River points into Oklahoma, Texas and the Southwest generally, were materially lowered by this potential competition.

There are more than five million tons of such freight annually. This subject has been threshed out in the House so frequently and is one with which the members are so familiar that it is unnecessary to dwell upon it further.

PROSPECTIVE GROWTH OF RIVER TRAFFIC.

When the great tributaries of the Mississippi are improved to the depths which traffic requires, in accordance with the projects now under way, the tonnage actually carried on the Mississippi River will grow to tremendous proportions. ^{100,000,000} A billion tons pass through Pittsburgh now annually—all of it of a character that would naturally seek cheap water transportation to the sea, but the Ohio River is only navigable by barges of sufficient draft to be economical during periods of high water. The Ohio Valley is one of the busiest valleys in the world; there are great manufacturing establishments along its shores as well as along the upper Mississippi and the Missouri and they are all looking forward to the opening of the Panama Canal with exceeding great interest. If our trade is not going to be tremendously increased with the countries which will be brought into closer commercial contact with us by the construction of the Panama Canal, why was this great expenditure of \$375,000,000 ever undertaken? The story of the decline of steamboat traffic on the Mississippi River has already been told. When it is recalled that only three and one-half million acres have been put into cultivation in the great valley from Cairo to the Gulf, it will be seen at once that when through traffic from the wonderfully-developed area north of Cairo was cut off in this way and prevented from using the river, this decline in the annual amount of tonnage borne was inevitable. The local traffic on the Ohio River has greatly increased as the territory bordering that river has been settled up and converted into a hive of industry, and this same result will most surely follow when the deltas of the Mississippi are in like manner put into cultivation and cities spring up along its banks. With the experience of the past, steamboat men have naturally been wary, but when the improvements contemplated by pending legislation are completed, in fact, when the work is begun in earnest fashion, there is every reason to believe that the old order of enterprise will again be established.

I quote once more from an article written by Judge Taylor, in which he refers to this particular feature:

"It is a disappointment to us all that commerce has not taken advantage of the increased channel depths in the Mississippi from St. Louis to New Orleans, as they have been developed within ten years past. But the reasons are not far to seek. The first is the uncertainty of their permanent maintenance. They depend upon annual appropriations by Congress.

* * * * *

It will take some strong, courageous, optimistic man, or group of men, to make a start in the navigation of the Mississippi below Cairo. Once started on a foundation of confidence it will grow. If there were a channel 10 feet deep from Chicago to New Orleans today, with public confidence in its permanence, it would be crowned with boats within ten years. If we postpone work for a 'demand' and discover no demand until we see men standing on the bank with money in their hands, there will never be any improved waterways. God Almighty did not wait for a demand from commerce before he made the Great Lakes.

Everybody is afraid of the Mississippi River. The people who live in its alluvial valley are afraid of its floods; steamboat men are afraid of its bars. The inhabitants are just beginning to take courage. The water has been held at bay for ten years. But an extraordinary flood, a few bad crevasses and the inundation of four or five thousand square miles would plunge them into despair again, from which it would take a long time to recover. We have a 9-foot low-water channel below Cairo nearly all the time for a little less than ten years. But it has not been entirely trustworthy. There have been some slips in the management of the dredges and some bars have gotten ahead of us for a few days a few times. Not often, nor for long, but enough to keep alive the sense of uncertainty. So men who would build big boats to navigate it wait, and keep waiting."

In his testimony before the Committee which appears on page 85 of the recent hearings, Col. Townsend explains the necessity of improving the great tributaries of the Mississippi and cites the fact that there were only a few which had a navigable depth of four feet. This fact leaves only the undeveloped deltas on either side of the river to furnish tonnage for the boats named, and as

there are only three and one-half million acres now in cultivation out of a total of twenty million, there is no occasion for surprise that the actual tonnage floated upon the river has so steadily decreased. On this point he said:

"Over one hundred million tons of freight annually passes through Pittsburgh, much of which is of a character which seeks cheap water transportation. The Ohio valley is teeming with factories whose products would naturally move down the river. The flour of Minneapolis and the grain of the Northwest are demanding cheaper transportation and it is from these sources that we must seek the commerce that will justify further development of the main stream. It is folly to expend hundreds of millions of dollars in creating a deep channel in the lower Mississippi River so long as boats navigating the tributaries cannot utilize existing depths. During the past low-water season there were few tributaries of the river which had a navigable depth of four feet, and its commerce was practically suspended, nor for lack of depth in its channel, but because there was no source from which freight could be derived."

In view of the fact that we are expending many millions to give the tributaries, the Ohio, the Upper Mississippi and the Missouri proper channel depth, I might add that it would be folly to expend these millions in creating a deep channel in the tributaries unless boats then navigating these tributaries could utilize the lower Mississippi River, and it has been very clearly shown that there is but one way to maintain this depth, and that is by levees and revetment.

FLOOD CONTROL IN THE INTEREST OF INTERSTATE COMMERCE.

Aside from the mere question of navigation of the Mississippi River, control of the floods is necessary in the interest of interstate commerce. Some of the great trunk lines of the country run from east to west across the deltas, and are seriously interfered with, and interstate traffic stopped for long periods of time, by the floods of the Mississippi. The railroads cross the river at St. Louis, Cairo, Memphis, Vicksburg, and New Orleans. In addition to these two great railroad systems run north and south through the deltas, the Illinois Central on the east bank, and the Iron Mountain on the west bank of the river. Traffic on these roads is tremendous. There

are several thousand miles of railroad subjected to overflow when the levees break. Mr. Bush, president of the Missouri Pacific-Iron Mountain system, recently stated:

The Mississippi River overflow in 1912 incapacitated 617 miles of the St. Louis, Iron Mountain and Southern Railway, of which 352 miles was under water, some of it for a period of over five months. The value of the road under water was over \$12,000,000, and the physical damage, as revealed by the repairs subsequently made, was \$415,000. The loss in traffic has been conservatively estimated at \$550,000, which would represent commerce to the value of \$5,500,000, which was destroyed. In addition to this there was a considerable loss occasioned by a great deal of the farming land contiguous to the river not being fit for cultivation the ensuing season.

For the year 1913 the physical damage to the Iron Mountain Railway was \$460,000, and the loss in traffic is estimated at \$196,000. This would make the total loss for the two years:

Physical damage.....	\$875,000	
Loss in traffic earnings.....	746,000	\$1,621,000
Estimated loss in retardation of commerce..	7,460,000	

The commerce borne by these roads is in no sense local. A mere glance at the map will suffice to make that point clear. This commerce in fact affects and touches every section of the country. There are not many manufacturing enterprises in the deltas. It is the great producer of raw materials, and these are all shipped to other sections of the country; whereas all the manufactured products which are consumed there are shipped from the various centers of distribution throughout the East, but the interruption of traffic on these railroads goes far beyond that. It stops the transportation of products from points far to the east of the overflowed valley destined to points far west. To interfere seriously with the operation of four thousand miles of railroad for some thirty to sixty and even to ninety days is a matter that materially affects the welfare and industrial activity of all the people. It is well worth recalling in this connection that the inland commerce of the Mississippi Valley is almost equal in its value to the aggregate value of the international commerce of the world. One illustration of the national character of this disaster was given by Mr. Bush in his statement before the committee when he cited the case of a manufacturing establishment in Baltimore with a plant more than a thousand miles

from the Mississippi River, which estimated its loss by the flood of 1912 at \$200,000. "Think of the effect on every small mill down in New England," declared Mr. Fairchild; "Think of the effect, the possible effect upon them now, of a partial failure of cotton crops during the last few years; think of the thousands and thousands of people all over our northern country who are so immediately affected in their daily lives by this, and then logically with all else that we have done and are doing, we should above all things promote the welfare of this Mississippi Valley."

This phase of the question is discussed fully by General T. C. Catchings and Governor Blanchard in their arguments on the constitutional question involved, which appear in a subsequent chapter.

THE MISSISSIPPI RIVER AND THE PANAMA CANAL.

In his statement, previously referred to, Mr. Fairchild said:

"Think of the great enterprise upon which we are entering in building a canal; to build a canal to connect the Atlantic and the Pacific. Think of what we are doing in the far East, in China, in extending our treaty relations, in taking up a position where we will have a greater influence and a greater access than ever before. Why? For what? To do what with them? To sell things to those people. What things? Why, the main thing we are to sell them is cotton—cotton goods. That is why we are willing to almost strain our relations with some of the nations of the world, that we may keep open markets. What we wish to sell in those markets is cotton goods. Now, if we do not take care of the production of the raw material of the cotton goods, all that we are doing in that respect is almost waste time, because we will cease to be a great cotton manufacturing country."

Such was the opinion of one of the most distinguished financiers and business men of our country. If the Panama Canal is ever to be worth the price which our country paid for it, a mere glance at the map will suffice to satisfy the most skeptical that the Mississippi River and its tributaries must be a most important factor in bringing about this result. It has been frequently stated that the Panama Canal would in effect empty the Mississippi River into the Pacific as well as into the Atlantic Ocean. There is no other such river in the world as the Mississippi. The valley which it drains and which has in the past been so dependent upon it for transportation facilities must look to it with increasing interest and dependence as the future demonstrates the wisdom of undertaking that great engineering enterprise at the Isthmus.

There can be no question that Congress, in response to the unanimous demand from the entire valley, which is endorsed throughout the country, has been convinced of the national importance of improving the navigable rivers of the Mississippi Valley. We are now well on our way to the completion of a project for a 9-foot depth in the Ohio River from Pittsburgh to Cairo.

This will cost \$63,000,000 when completed. We are prosecuting with equal rapidity the improvement of the Missouri River from Kansas City with a view to securing an equal depth in that river. This project will cost \$20,000,000. We are canalizing the Mississippi River above the mouth of the Missouri, and we have secured and now maintain a channel of nine feet from the mouth of the Mississippi to the mouth of the Ohio—2,500 miles of navigable rivers nine feet deep, from the Gulf of Mexico into the very heart of this marvelous valley. The total mileage of all the navigable tributaries, however, far exceeds this 2,500 miles of trunk line; there are in fact about 15,000 miles. The main trunk line into which all of the tributaries flow is that reach of the Mississippi River from Cairo south. It has been stated and demonstrated elsewhere that this reach of the river cannot be maintained to the required depth without levees and revetment. Is it worth while?

In 1911, Hon. O. P. Austin, Chief of the Bureau of Statistics, in the Department of Commerce and Labor, delivered an address before the Deeper Waterways Association at Chicago on the subject of the Panama Canal and the Mississippi Valley. The subject is handled by Mr. Austin so far beyond my ability to treat it, and so illuminates the subject in hand that I quote from it fully:

The relation of the Panama Canal to the Mississippi Valley may be stated in a single sentence: The Mississippi Valley can not attain complete commercial success without the Panama Canal; the Panama Canal cannot attain complete commercial success without the Mississippi Valley, re-enforced by deeper waterways from the Lakes to the Gulf.

AN OPEN DOOR FOR THE WORLD'S GREATEST PRODUCING AREA.

What is the Panama Canal? A ditch 50 miles long, 500 feet wide, 40 feet deep, connecting, for purposes of international commerce, the two greatest oceans of the world. What is the Mississippi Valley? The world's greatest single producer of the principal articles forming international commerce. What are you gentlemen gathered here proposing for this Mississippi Valley? A system which shall give to its products through water transportation from the place of production to the Panama Canal and thence direct to the trade centers of countries having half of the world's population. Hence the relation of the Panama Canal to the commerce of the Mississippi Valley will be that of the most direct and cheapest route of transportation from the door of the producer to the door of the consumer. May we expect that the opening of the Panama

Canal will be followed by an improvement in the trade of this valley with the markets of the Pacific? Undoubtedly. May we expect that the development of deeper waterways from the Lakes to the Gulf will still further improve the commerce of this valley with the markets of the Pacific and, indeed, the markets of the whole world? Beyond any possible doubt.

THE MISSISSIPPI VALLEY AS A PURVEYOR TO WORLD MARKETS.

You will expect of me some reason for the opinions which I have here expressed. Let me give them to you in brief:

First. The Mississippi Valley is already the world's greatest single producer of a large proportion of the articles entering commerce and required for that commerce.

Second. It has already exceptional facilities for distributing its products to the market fronting upon the Atlantic, and the canal will give it similar facilities for the markets fronting upon the Pacific.

Third. These exceptional conditions of producing power and opportunities of distribution are so largely the result of natural conditions that we may look upon them when once attained as a permanent part of the world's system of production and interchanges.

What, then, is the Mississippi Valley as a contributor to the world's commerce? First, a great Temperate Zone area, equal in extent to all Europe except Russia, lying between two mountain ranges, with a Great Lakes system at the north and 19,000 miles of navigable rivers flowing to tidewater at the south. These rivers there mingle with those of another river, the Gulf Stream, flowing toward Europe at a speed even greater than that of the Mississippi, while at the western end of the Panama Canal we shall find another ocean current moving westward across the Pacific at the rate of 25 miles a day. In addition to these natural transportation facilities, the art of man has given to this valley 150,000 miles of railway—one-fourth the railway mileage of the world—and every year a larger percentage of this mileage moves its trains in a north-and-south direction, and the percentage of our exports passing out at the ports at the south increases from year to year.

UNITED STATES IN WORLD'S PRODUCTION.

The United States as a whole is the world's largest single producer of many of the articles of the world's requirements. We produce three-fourths of the world's corn, two-thirds of its cotton, nearly two-thirds of its petroleum, one-half of its copper, nearly one-half of its pig iron, two-fifths of its coal, and more than any other country of its wheat and oats and meat and tobacco and lumber and manufactures.

SHARE OF OUR PRODUCTS ORIGINATING IN THE VALLEY.

Of our own production of these articles the Mississippi Valley produces 85 per cent of the corn, 75 per cent of the wheat, 70 per cent of the live stock, 70 per cent of the cotton, 70 per cent of the iron ore, 70 per cent of the petroleum, 50 per cent of the wool, 50 per cent of the copper, 50 per cent of the lumber, 50 per cent of the coal, about 40 per cent of the manufactures, and has nearly 70 per cent of the farm areas and farm values of the country. As a result of these conditions, the plentiful supply of cotton, wool, iron, copper, lumber, coal, petroleum, and food of all kinds, this valley is enlarging its share in the rapidly increasing production of manufactures in the United States. Our country is already the world's greatest manufacturer. The gross value of our manufactures has grown from four and one-fourth billion dollars in 1870 to five and one-third billions in 1880, nine and one-third billions in 1890, thirteen billions in 1900, fifteen billions in 1905, and practically twenty billions in 1910, while the share which the Mississippi Valley has produced of this rapidly increasing total was, in 1870, 27 per cent; in 1880, 30 per cent; in 1890, 35 per cent; in 1905, 38 per cent; and in 1910, nearly 40 per cent. The gross value of manufactures provided in this valley has grown from one billion dollars in 1870 to seven and one-half billions in 1910.

PERMANENCE OF PRODUCING POWER.

May we expect a continuation of the wonderful producing power of this valley? Yes. Once the bed of an ocean, it thus received the basis of a strong and durable soil, and to this the glacial period contributed in the section lying north of the Ohio River additional soil and soil material brought from the far north, while washings from the mountain sides through centuries of time contributed to the soil of the sections farther south. Another contributor to the productiveness, and especially the permanence of production in this valley, is the reliable rainfall, largely due to that great westward air current, a result of the eastward movement of the earth, which crosses the Atlantic near the Equator, where evaporation from the ocean is very great, and, deflected northward by the great mountain ranges, passes up the Mississippi Valley, and, cooling as it rises and moves northward, discharges the condensed moisture, giving to this area a more evenly distributed and reliable rainfall than is enjoyed by any other like Temperate Zone area of the world. Thus we may assume that the producing power of the valley as a whole is to continue indefinitely.

PERMANENCE OF VALLEY'S COMMERCE.

Will its status as a contributor to the world's commerce continue? Yes. We have become the world's largest producer of cot-

ton and corn and wheat and meats chiefly through the natural conditions just mentioned, and we may expect that the system of strengthening the soils by an intelligent study of their requirements will continue our producing power indefinitely. While we are requiring for our own use a steadily increasing share of our food products, manufactures are becoming from year to year a larger share of our growing export trade, and this section is, as I have already shown you, steadily increasing the proportion which it supplies to this growing factor of commerce.

GROWTH OF MANUFACTURING IN THE MISSISSIPPI VALLEY.

The gross value of manufactures produced in the Mississippi Valley has grown, according to the official figures of the Census Bureau, from one billion dollars in 1870 to one and two-thirds billions in 1880, three and one-fourth billions in 1890, four and three-fourths billions in 1900, five and two-thirds billions in 1905, and seven and one-half billions in 1910, and the value of its other products is probably about an equal sum. The gross value of all the products of the Mississippi Valley may then be set down at approximately \$15,000,000,000 per annum, a value as great as that of all the merchandise entering the international markets of the entire world.

Thus we may reasonably expect, indeed we may feel an absolute assurance, that the contributions of this valley to the international commerce of the world are not only to continue at their present enormous total, but will increase from year to year and decade to decade.

THE CANAL AN OPEN DOOR TO GREAT MARKETS

Now, as to the relation which the Panama Canal is to prove to this great and increasing commerce of the Mississippi Valley. It will become an "open door," a direct route to the trade, first, of all the western coast of America; second, of all the eastern coast of Asia; and, third, of that rapidly developing section known as Oceania.

SHORTNESS OF PANAMA CANAL ROUTE.

Look at the map of the world and you will see that the western coast of South America lies due south of the eastern coast of the United States, thus making the Panama Canal the direct route from the Mississippi Valley to all of the western coast of the South American Continent, and, of course, by far the shortest water route to all the western coast of the North American Continent. To Yokohama the trade center of Japan and one of the great commercial cities of Asia, the distance from New Orleans by way of Panama is 9,268 miles against 14,471 miles via the Suez Canal. To Shanghai, the commercial center of China and one of the most important of the Asiatic ports, the distance from New Orleans via Panama is 10,264 miles against 13,750 miles via Suez. To Hongkong, one of the

chief distributors of merchandise of eastern Asia, the distance from New Orleans via Panama is 10,830 miles and via Suez 12,892 miles. To our own Philippine Islands, with which the trade is rapidly increasing under the new relations providing for free interchange between those islands and the United States, the distance from New Orleans via Panama is 10,993 miles against 12,946 miles via the Suez Canal. To Melbourne, one of the largest importing ports of Australia, in which country American goods are especially popular, the distance from New Orleans is 9,427 miles by way of Panama and 14,303 miles via Suez. To Wellington, New Zealand, to which our exports also show a rapid growth, the distance from New Orleans via Panama is 7,939 miles against 15,620 miles via Suez.

CANAL WILL GREATLY SHORTEN ROUTES TO PACIFIC PORTS.

Thus the opening of the Panama Canal will shorten the steamship routes from New Orleans to Manila 1,953 miles; to Hongkong, 2,062 miles; to Shanghai, 3,496 miles; to Melbourne, 4,876 miles; to Yokohama, 5,203 miles; and to Wellington, 7,861 miles. More than that, it will place New Orleans nearer to most of these ports than is London, the great commercial center of our principal rival in the oriental trade. The steamship distance from London via the Suez Canal to Yokohama, as given by an accepted authority, is 11,245 miles, against the distance from New Orleans via the Panama Canal to Yokohama, 9,268 miles; London to Shanghai, 10,650 miles; New Orleans to Shanghai, 10,254 miles; London to Melbourne, Australia, 11,250 miles; New Orleans to Melbourne, 9,247 miles; London to Wellington, New Zealand, 12,615 miles; New Orleans to Wellington, 7,939 miles, thus placing New Orleans 369 miles nearer to Shanghai, 1,723 miles nearer to Melbourne, 1,977 miles nearer to Yokohama, and 4,676 miles nearer to Wellington, New Zealand, than is the chief commercial center of our chief rival in the oriental trade—London, England.

VALUE OF THE MARKETS TO BE REACHED THROUGH THE CANAL.

Thus we may assume that the Canal is to bring this valley much nearer than at the present time to practically all the countries fronting upon the Pacific, and considerably nearer than is London to many of them. Now let us see what their trade amounts to, and how much we are at present getting of it, and thus be in position to arrive at some intelligent estimate of the prospective value of the Panama Canal as a shorter route to that trade for the products of the Mississippi Valley. The total value of the merchandise entering the ports of the western coast of America other than the United States now exceeds \$300,000,000 per annum, and is rapidly increasing, while the recent completion of a through railway line connecting Argentina with the Pacific coast will, when the Panama Canal shall have been opened, offer a direct route from the Gulf ports to the markets of

Argentina, whose imports alone aggregate \$300,000,000 per annum. Crossing the Pacific we find the imports of Japan from \$250,000,000 to \$300,000,000 per annum; China, from three hundred to approximately three hundred and fifty million; Hongkong, estimated at approximately one hundred and fifty million; Australia and New Zealand, four hundred million; and the Philippine and Hawaiian Islands, seventy-five million dollars a year, making the total imports of the foreign countries which are to be brought nearer to you by the Panama Canal about one and one-half billion dollars per annum. Add to this the trade of the western coast of the United States, which you of the Mississippi Valley will be able to reach at less cost of transportation by water through the Panama Canal than by land over the Rocky Mountains, and you get a market approximately \$2,000,000,000 per annum, in which the Panama Canal will give you new advantages and new opportunities.

WATER TRANSPORTATION MUCH CHEAPER THAN ON LAND.

And while I need not impress upon you gentlemen the importance of substituting water transportation for that by land, your views in this direction will perhaps be strengthened when I tell you that the charge for transporting wheat by rail from Chicago to New York, a distance of 1,000 miles, has averaged during the last decade a little over ten cents per bushel, while the average rate per bushel during the same period for the same wheat passing from New York to Liverpool, a distance of 3,000 miles, was 3 cents a bushel. Ten cents per bushel for 1,000 miles by rail; 1 cent per bushel for 1,000 miles by ocean steamer, and that, too, the annual average during the 10-year period, 1900-1910.

PROXIMITY INCREASES OUR SHARE IN SUPPLYING MARKETS.

Now, let us consider the effects of proximity and satisfactory transportation facilities in determining the share which we may obtain of the import trade of these countries—of any country, in fact. To determine this, approximately, at least, we have but to examine the records of our trade with various parts of the world at the present time. Take, for example, the countries lying directly south of us. In all those lying north of the Equator and reached by plentiful steamship facilities we supply from 30 to 60 per cent of their total imports. The moment, however, we pass to the southern sections of South America the share which we supply of their imports drops to approximately 10 per cent, and this is also true of the share which we obtain of the imports of practically all the Asiatic territory fronting upon the Pacific Ocean. Taken as a whole, we now supply approximately 10 per cent of the imports of the area bordering upon the Pacific, exclusive of that under the American flag. And if our experience with that portion of Latin America which we already reach by direct and plentiful steamship facilities is to be a guide in deter-

mining the effect of more direct water communication with the countries fronting on the Pacific, we may expect to greatly increase the percentage which we now supply of their imports.

MANUFACTURES FORM GROWING SHARE OF EXPORTS.

Still another reason why we should, and must, indeed, cultivate these markets is the fact that manufactures form a large part of their imports, and it is in manufactures, in which we must make our greatest efforts for enlargement of our exports. The share of our wheat and corn and meats which we can spare for foreign countries is steadily decreasing, and we are also increasing the home consumption of our cotton. We can therefore only expect to maintain the growth in our export trade by increasing our exports of manufactures, and we are doing this. Our exports of manufactures have grown from \$180,000,000 in 1890 and \$475,000,000 in 1900 to over \$900,000,000 in the fiscal year just ended, and the share which they formed of the total exports has increased from 21 per cent in 1890 and 35 per cent in 1900 to 45 per cent in 1911, while the share which foodstuffs form of the exports has fallen from 440 per cent in 1900 to 19 per cent in 1911.

MANUFACTURES CHIEF REQUIREMENT OF PACIFIC MARKETS.

If we are to increase our exports of manufactures it must be by increasing the trade with the sections of the world which require that class of merchandise; and while it is true that manufactures form 45 per cent of our exports as a whole, the fact that they form 75 per cent of the exports to Asia and 85 per cent of those to Oceania and South America and but 35 per cent of those to Europe renders an enlargement of the Pacific trade of especial importance to the Mississippi Valley, which last year produced \$7,500,000,000 worth of manufactures, or about 40 per cent of the entire output of the United States.

MUTUAL INTERDEPENDENCE OF THE CANAL AND THE VALLEY.

I therefore close with the assertion with which I began this discussion; the Mississippi Valley can not attain complete commercial success without the Panama Canal, and the Panama Canal can not attain complete commercial success without the Mississippi Valley, re-enforced by deeper waterways from the Lakes to the Gulf.

THE CONSTITUTIONAL QUESTIONS INVOLVED.

In view of the fact that the improvement of the Mississippi River has been in progress for more than thirty years, or to be more specific, ever since the third of March, 1881, when the project was definitely adopted by Congress, it would seem entirely unnecessary to discuss the question of the power of Congress under the constitution to make the appropriations asked for. Power, of course, is not wanting to complete a project which was ample to warrant its undertaking. However, as this question is so frequently raised, it is thought worth while to consider it here. In his address before the Memphis Convention, Mr. Calhoun stated his theory as follows:

"He did not, himself, believe in the power of the General Government to conduct a system of internal improvement. He had, independently of other objections, seen the evil effects of it, in too many instances, where it has been attempted, and the system of log-rolling which ensued; but, in relation to the great highway of western commerce, at least, the great inland sea of the country, the Mississippi, he did not, for a moment, question that government was as much obligated to protect, defend, and improve it in every particular, as it was to conduct these operations on the Atlantic seaboard."

He then laid down this formula by which to test the constitutionality of all questions of similar import:

"It is the genius of our government, and what is to me its beautiful feature, that what individual enterprise can effect alone is to be left to individual enterprise; what a state and individuals can achieve together is left to the joint action of states and individuals; but what neither of these separately or cojoined are able to accomplish, that and that only is the province of the Federal Government. I think this is the case in reference to the Mississippi River."

Certainly the facts which have been related heretofore must convince the most skeptical that the problem presented by the

floods of the Mississippi bring this question of their control clearly within the limitations of Mr. Calhoun's definition.

The letter of Thomas H. Benton to the delegates at the Chicago Convention of 1847 has been quoted from. In this he erects the following standard by which to measure the constitutionality of any proposed public improvement:

"Objects of general and national importance can alone claim the aid of the Federal Government and in favor of such objects I believe all the departments of the government to be united. Confined to them and the constitution can reach them, and the treasury sustain them. Extended to local or sectional objects and neither the constitution, nor the Treasury could uphold them. National objects of improvement are few in number, definite in character, and manageable by the Treasury. Local and sectional objects are innumerable, and indefinite, and ruinous to the Treasury."

Applying this test to the Mississippi River, he concluded that its problems were of such general and national importance as to bring them within the power delegated by the constitution to the Federal Government.

General T. C. Catchings and Governor N. C. Blanchard, of Louisiana, both served many years with great distinction as members of the House of Representatives and each, at different times, was Chairman of the Committee on Rivers and Harbors.

General Catchings is one of the ablest lawyers in the country and his opinion on the constitutionality of any proposition must carry great weight. No man has studied the particular questions here involved more thoroughly than has General Catchings and for this reason he was requested to prepare a brief for use in this connection.

Governor Blanchard, after his retirement from Congress, served with great distinction on the bench of the Supreme Court of Louisiana and his ability as a lawyer is recognized throughout the Mississippi Valley. The brief of General Catchings and an argument made by Mr. Blanchard while a member of this House are reproduced with the confident belief that a careful perusal of either must bring conviction to any open mind:

BRIEF BY GEN. T. C. CATCHINGS ON THE POWER OF CONGRESS TO APPROPRIATE MONEY FOR THE CONSTRUCTION OF LEVEES FOR FLOOD PROTECTION.

What is commonly called the "Ransdell-Humphreys bill" does not by its terms seek an appropriation to protect the Mississippi Valley from floods for the purpose of conferring a benefit upon the owners of the lands in the valley. It provides an appropriation for continuing the improvement of the Mississippi River from the Head of Passes to the mouth of the Ohio River, including the salaries, clerical fees, traveling and miscellaneous expenses of the Mississippi River Commission, with a view to securing a permanent channel depth of 9 feet, preventing the banks of the river from caving, and protecting the valley from floods. The appropriation sought by it is to be expended under the direction of the Secretary of War in accordance with the plans, specifications, and recommendations of the Mississippi River Commission, as approved by the Chief of Engineers, for the general improvement of the river for surveys, including a survey from the Head of Passes to the headwaters of the river, in such manner as in their opinion shall best improve navigation and promote the interest of commerce at all stages of the river, and for the building of levees between the Head of Passes and Cape Girardeau, Mo.

In addition to the twelve millions sought to be appropriated for immediate use, the Secretary of War is authorized, by hired labor or otherwise, to continuously carry on the aforesaid plans of the Mississippi River Commission, to be paid for as appropriations may be made from time to time by law, not to exceed in the aggregate forty-eight millions in addition to the twelve millions intended to be immediately available.

The bill provides that the forty-eight millions shall be used in prosecuting the improvement for not less than four years, the work for each year to cost approximately \$12,000,000. It directs that of the money appropriated and authorized to be expended nine millions per annum of so much as may be necessary, shall be expended in the protection, repair, and construction of levees. The balance of the appropriation is directed to be used in the construction and repair of bank revetment and for work in the interest of navigation, including the construction of suitable and necessary dredge boats and other devices and appliances, and in the maintenance and operation of the same.

It is then stipulated that in the discretion of the Mississippi River Commission, upon the approval of the Chief of Engineers, allotments may be made from the amounts appropriated or authorized for improvements now under way or hereafter to be undertaken upon water courses connected with the Mississippi River, and in harbors upon it now under control of the commission and under improvement.

The bill contains no statement as to why appropriations are sought for protecting the Mississippi Valley from floods. There is a simple declaration that the appropriation is made, among other things, for the purpose of protecting the valley from floods. The bill gives no reason why nine millions per annum are directed to be expended in the protection, repair, and construction of levees; that is to say, the purpose to be subserved by the protection, repair, and construction of levees is not indicated. The statement that the balance of the appropriation shall be used in the construction and repair of bank revetment, and for work in the interest of navigation, including the construction of suitable and necessary dredge boats and other devices and appliances, and in the maintenance and operation of the same, is simply descriptive of the manner in which such balance of the appropriation shall be expended. The words "in the interest of navigation" do not imply that building levees is not in the interest of navigation, and are simply descriptive of the character of the work specifically defined in the concluding portion of the sentence in which these words appear. That is to say, the appropriation referred to as "the balance of the twelve millions annually," is specifically devoted to the construction and repair of bank revetment, the construction of suitable and necessary dredge boats, and other devices and appliances, and for the maintenance and operation of the same, and for work in the interest of navigation. This means that if there should be any other work which in the judgment of the commission should be done in the interest of navigation other than that specifically designed, they shall do that work.

Levees are not referred to in this closing paragraph for the reason that they have already been specifically provided for.

Although the purpose for which appropriations for the construction and maintenance of levees are sought by the bill is not expressed, yet the appropriations, if made, will be just as valid as if the purpose in making them had been expressed. The only question which could be raised, if we assume that the appropriations are made, will be as to whether the construction of levees bears any proper relation to the powers of the Government under the Constitution.

In the case of *Cherokee Nation v. Southern Kansas Ry. C.* (135 U. S., 641), the Supreme Court said:

It is not necessary that an act of Congress should express in words the purpose for which it was passed. The court will determine for itself whether the means employed by Congress have any relation to the powers granted by the Constitution.

And Congress has a very great latitude in determining by what means it will perform an act which it has authority under the Constitution to perform.

In *McCulloch v. State of Maryland* (4 Wheat., 409), Chief Justice Marshall said:

The Government which has a right to do an act, and which has imposed upon it the duty of performing that act, must according to the dictates of reason be allowed to select the means; and those who contend that it may not select any appropriate means, that any particular mode of effecting the object is excepted, take upon themselves the burden of establishing that exception.

And again, on page 413, he said:

To employ the means necessary to an end is generally understood as employing any means calculated to produce the end, and not as being confined to those single means without which the end would be entirely unattainable.

And on page 423 he said:

But where the law is not prohibited and is really calculated to effect any of the objects intrusted to the Government, to undertake here to inquire into the degree of its necessity would be to pass the line which circumscribes the judicial department and to tread on legislative ground. The court disclaims all pretensions to such power.

And on page 421 he said:

We admit, as all must admit, that the powers of the Government are limited, and that its limits are not to be transcended. But we think the sound construction of the Constitution must allow to the National Legislature that discretion, with respect to the means by which the powers it confers are to be carried into execution, which will enable that body to perform the high duties assigned to it in the manner most beneficial to the people. Let the end be legitimate, yet it be within the scope of the Constitution, and all means which are appropriate, which are plainly adapted to that end, which are not prohibited, but consist with the letter and spirit of the Constitution, are constitutional.

The Constitution expressly confers upon Congress the power to make all laws which shall be necessary and proper for carrying

into execution its enumerated powers and all other powers vested in the Government of the United States or in any department or officer thereof.

Discussing the clause of the Constitution conferring this power to make all such necessary and proper laws, the Supreme Court, in the legal tender case of *Juilliard v. Greenman* (110 U. S., 440), said:

By the settled construction and the only reasonable interpretation of this clause the words "necessary and proper" are not limited to such measures as are absolutely and indispensably necessary, without which the powers granted must fail of execution; but they include all appropriate means which are conducive or adapted to the end to be accomplished and which in the judgment of Congress will most advantageously effect it.

It quoted with approval from the opinion of Chief Justice Marshall in the early case of *United States v. Fisher* (2 Cranch, 358) as follows:

In construing this clause it would be incorrect and would produce endless difficulties if the opinion should be maintained that no law was authorized which was not indispensably necessary to give effect to a specified power. Where various systems might be adopted for that purpose it might be said with respect to each that it was not necessary, because the end might be obtained by other means. Congress must possess the choice of means and must be empowered to use any means which are, in, fact, conducive to the exercise of a power granted by the Constitution.

The question, therefore, is as to whether the construction of levees and the prevention thereby of floods in the Mississippi Valley may justly be regarded as one means for the regulation, and as a necessary incident thereof, the protection of interstate commerce, and the facilities for the transportation of mails, whether by steam vessels engaged in the navigation of the Mississippi River or by railroads traversing the large area of territory embraced in what is known as the Mississippi Valley.

What is generally known as the Mississippi Delta has an area of 29,000 square miles of territory, all of which is exposed to more or less serious damage by the flooded waters of the Mississippi River. The delta comprises portions of seven of the States. Something like 1,000,000 people reside in this delta. Many railroads traverse it, and many villages and a number of considerable towns or cities are located within its area, and a very extensive intercourse through interstate commerce and the postal business of the

Government is carried on between the inhabitants of this delta and the States of this Union.

The serious attention of Congress was directed to the magnitude of the interests centered in this delta and to the great possibilities of its increase in population, with consequent growth of interstate commerce and postal business, as far back as 1879, when it created the Mississippi River Commission. The duties of that commission in the main were as follows:

To direct and complete such surveys of said river between the Head of the Passes near its mouth and its headwaters and to make such additional surveys, examinations, and investigations, topographical, hydrographical, and hydrometrical, of said river and its tributaries as may be deemed necessary by said commission to carry out the objects of this act, * * * to take into consideration and mature such plans and estimates as will correct, permanently locate, and deepen the channel, and protect the banks of the Mississippi River; improve and give ease and safety to the navigation thereof; prevent destructive floods; promote and facilitate commerce, trade, and postal service.

It is not worth while to discuss with any detail the question as to the value of the confinement of the floods of the river as a means to the improvement of its channel. Congress has access to the many reports made from that day to this by the Mississippi River Commission in which this question has been from time to time more or less discussed. It is sufficient to say that the members of the commission have differed in their opinions as to the efficacy of levees in the work of channel improvement. Some of them have steadily maintained that the confinement of the flood waters serves a useful purpose in maintaining the channel and in deepening it, and by that means improving it. Others have doubted whether the confinement of the floods would have any material effect upon the channel. Congress, however, has proceeded for many years upon the view of those who thought that the confinement of the floods operated beneficially in the great work of channel improvement. Large sums of money have been expended by the Government in the construction of levees. The inhabitants of the Delta have cooperated freely and actively, and, stated broadly, have expended considerably more than twice as much as the Government has in this direction. The result of it all is that there now exists very considerably protection from floods. It is the belief that ordinary floods can be substantially restrained by the levees as they exist. They need, however, to be greatly enlarged and strengthened to enable them to cope with such great floods as that which passed down during the last 12 months.

The soil through which the river runs being alluvial and consequently very friable, the banks cave badly, and it is essential not only to channel improvement but to the permanence of any system of levees that at the worst places the banks shall be revetted to prevent their caving. Bank revetment, therefore, may be regarded not only as a feature of channel improvement but as a feature of levee construction. It is within the power of Congress, under the interstate-commerce clause, as defined in the quotations made from the several opinions of the Supreme Court of the United States, too clearly it would seem to admit of controversy, if it chooses to accept the view that levee construction has a direct relation to channel improvement, and, therefore, to the improvement of the navigation of the river, to expend money for the purpose of constructing levees. The courts would never deny the power of Congress to make such appropriations.

This question must not be considered, however, purely as one affecting the navigation of the river. As said by Mr. Justice Nelson, in delivering the opinion of the court in *Penn v. Wheeling & B. Bridge Co.* (18 How., 421): "the regulation of commerce includes intercourse and navigation." That is to say, under the interstate-commerce clause, Congress is not limited to questions of navigation, but may consider and deal with questions of intercourse as well. All of the members of the commission, it is believed, have been of the opinion that the construction of levees, leaving out of consideration entirely the mere question of navigation, facilitates commerce and trade. For example, in their report for 1885 the commission said that they "promote and facilitate commerce and trade by establishing banks or landing places above the reach of floods upon which produce can be placed while awaiting shipment, and where steamboats and other river craft can land in times of high water." The truth of this statement must be manifest. If the whole Mississippi Delta were covered by water there would indeed be no commerce upon the river at all, and consequently no navigation of it.

Again, in their report for 1912 they say that levees have a certain degree of utility in the improvement of the channel "and are necessary to promote the interests of commerce by providing landing places for the interchange of traffic in times of flood and protecting the lines of railway behind them."

It is self-evident, therefore, that, leaving out of consideration entirely all questions relating to the mere navigation of the Mississippi River, Congress has the power under the interstate-commerce clause to construct levees as a suitable means for promoting the interests of commerce.

It is submitted that if the Mississippi River was incapable of navigation at all, Congress would still have the power to prevent the

escape of its flood waters by the construction of levees. In *Cal. v. Pac. R. R. Co.* (127 U. S., 39) the Supreme Court said:

It can not at the present day be doubted that Congress, under the power to regulate commerce among the several States, as well as to provide for postal accommodations and military exigencies, had authority to pass these laws. The power to construct, or to authorize individuals or corporations to construct, national highways and bridges from State to State is essential to the complete control and regulation of interstate commerce. Without authority in Congress to establish and maintain such highways and bridges it would be without authority to regulate one of the most important adjuncts of commerce. This power in former times was exerted to a very limited extent, the Cumberland or National Road being the most notable instance. Its exertion was but little called for, as commerce was then mostly conducted by water and many of our statesmen entertained doubts as to the existence of the power to establish ways of communication by land. But since, in consequence of the expansion of the country, the multiplication of its products, and the invention of railroads and locomotion by steam, land transportation has so vastly increased a sounder consideration of the subject has prevailed and led to the conclusion that Congress has plenary power over the whole subject. Of course the authority of Congress over the Territories of the United States, and its power to grant franchises exercisable therein, are, and ever have been, undoubted. But the wider power was very freely exercised, and much to the general satisfaction, in the creation of the vast system of railroads connecting the East with the West, traversing States as well as Territories, and employing the agency of the State as well as Federal corporations.

In *Luxton v. North River Bridge Co.* (153 U. S., 533) the foregoing excerpt was quoted with approval, and the court, among other things, said:

The Congress of the United States, being empowered by the Constitution to regulate commerce among the several States and to pass all laws necessary and proper for carrying into execution any of the powers specifically conferred, may make use of any proper means for that end.

It can not be doubted that under its power to regulate commerce Congress itself might have provided for the construction of railroads traversing the Mississippi Delta. If it had done so it would unquestionably have the power to give effect to its purpose in con-

structing such railroads; that is to say, it would have the power by any suitable means to prevent any obstruction to their operation. Congress may not only, under the power to regulate commerce, cause railroads to be constructed, but it may adopt as agents railroads constructed by individuals or corporations. This results from the power which Congress has to adopt any means which may reasonably be deemed necessary or proper to enable it to regulate interstate commerce. The act of July 24, 1866, which is section 5263 of the Revised Statutes, provides as follows:

Any telegraph company now organized or which may hereafter be organized under the laws of any State shall have the right to construct, maintain, and operate lines of telegraph through and over any portion of the public domain of the United States, over and along any of the military or post roads of the United States which have been or may hereafter be declared such by law, and over, under, or across the navigable streams or waters of the United States; but such lines of telegraph shall be so constructed and maintained as not to obstruct the navigation of such streams and waters or interfere with the ordinary travel on such military or post roads.

In *Telegraph Co. v. Texas* (105 U. S., 460) it was expressly held that a telegraph company which had accepted the restrictions and obligations indicated in this statute became an instrument of foreign and interstate commerce and a Government agent for the transmission of messages on public business. The exact language of the court is as follows:

The Western Union Telegraph Co., having accepted the restrictions and obligations of this provision by Congress, occupies in Texas the position of an instrument of foreign and interstate commerce and of a Government agent for the transmission of messages on public business.

It thus appears that it has been distinctly held that instead of constructing itself the necessary facilities for the transaction of interstate commerce, it may make any private person or corporation its agent. Having made the Western Union Telegraph Co. an instrument of foreign and interstate commerce and a Government agent for the transmission of messages on public business, it held, in the case of *Western Union Telegraph Co. v. Massachusetts* (125 U. S., 530), that while the telegraph company was subject to taxation by the State of Massachusetts, that State could not interfere with or prevent the discharge of its functions as an instrument of foreign and interstate commerce and as a Government agent for the transmission of messages on public business.

Referring to this case in the later one of *Western Union Telegraph Co. v. Pennsylvania R. R. Co.* (195 U. S., 565), the court said:

It enforced the right given by that act and gave to the telegraph company the protection of the national power and supremacy and differs only in the instance, not in the principal, declared in the *Pensacola* case.

In the case of the *United States v. Union Pacific R. R. Co.* (160 U. S., 1) it was held that the act of 1866 was not only effective to prevent any interference by a State with the operation of telegraph companies which had accepted the provisions of that act, but that it also affected railroad companies so as to prevent them by contract from excluding from their roadways any telegraph company incorporated under the laws of the State that had accepted the provisions of that act, and desired to use their roadways for its line in such manner as not to interfere with the ordinary travel thereon. In other words, a telegraph company accepting the provisions of that act, having become by virtue of it an instrument of foreign and interstate commerce and the agent of the Government for the transmission of messages on public business, can not be prevented, either by a State or by a railroad company, from discharging its functions. The laws of the United States when made in pursuance of the Constitution being supreme, they must be effective, no matter by whom questioned.

Congress has likewise and to the same effect constituted all railroad companies whose roads are operated by steam instruments of foreign and interstate commerce and agents of the Government for the transportation of mails, thus placing them in a similar attitude to that occupied by the *Western Union Telegraph Co.* as defined by the Supreme Court in the cases referred to. Section 5258 of the Revised Statutes is as follows:

Every railroad company in the United States whose road is operated by steam, its successors and assigns, is hereby authorized to carry upon and over its road, boats, bridges, and ferries, all passengers, troops, Government supplies, mails, freight, and other property on their way from any State to another State, and to receive compensation therefor, and to connect with roads of other States so as to form continuous lines for the transportation of the same to the place of destination. But this section shall not affect any stipulation between the Government of the United States and any railroad company for transportation or fares without compensation, nor impair or change the conditions imposed by the terms of any act granting lands to any such company to aid in the construction

of its road, nor shall it be construed to authorize any other railroad without authority from the State in which such railroad or connection may be proposed. And Congress may at any time alter, amend, or repeal this section.

The effect of this statute is to confer a most valuable franchise upon all of the railroad companies in the United States operated by steam. It confers a franchise which the States could not interfere with if they desire to do so, as clearly held in the case of *Western Union Telegraph Co. v. Massachusetts* (125 U. S.), above cited. Congress, therefore, has appointed all railroad companies in the United States whose roads are operated by steam, including of course, those traversing the Mississippi Delta, instruments of foreign and interstate commerce and agents of the Government for the transportation of troops, Government supplies, and mails on their way from one State to another State.

Section 3964 of the Revised Statutes is in part as follows:

What are post roads?

The following are established post roads:

All the waters of the United States during the time the mail is carried thereon.

All railroads or parts of railroads which are now or hereafter may be in operation.

The effect of this statute is likewise to constitute all railroads or parts of railroads then or which might thereafter be in operation agents of the Government for the purpose of transporting the mails of the Government.

The Government conducts all postal affairs itself, but in doing this it must employ agents. Hence the enactment of this statute, by which all railroads or part of railroads are constituted agents to assist the Government in the conduct of its postal affairs. Having the power, as we have shown, to appoint agents to assist it in the conduct of its business, it necessarily follows that it has the power to make these agencies effective, which includes, of course, the power to remove all obstructions which might affect their efficacy. So far as railroads are concerned, it must have the power to remove any obstructions which might interfere with their operation and so with their ability to serve the Government in the transportation of its troops, supplies, and mails.

The power of the Government to remove obstructions from interstate commerce is not confined to its conduct by water. It has the same power upon the land that it has upon the water. This is expressly declared in the *Debbs* case, reported in 158 United States, 564. The court quoted as follows from the opinion in *Gilman v. Philadelphia* (3 Wall., 713), to wit:

The power to regulate commerce comprehends the control for that purpose and to the extent necessary of all the navigable waters of the United States which are accessible from a State other than those in which they lie. For this purpose they are the public property of the Nation, and subject to all the requisite legislation by Congress. This necessarily includes the power to keep them open and free from any obstruction to their navigation, interposed by the States or otherwise; to remove such obstructions when they exist; and to provide by such sanctions as they may deem proper, against the occurrence of the evil and for the punishment of offenders. For these purposes Congress possesses all the powers which existed in the States before the adoption of the national Constitution, and which have always existed in the Parliament in England.

It will be noted that in this Philadelphia case it was declared that the power to regulate commerce includes the power to keep all navigable waters free from any obstruction interposed by the States or otherwise. That is to say, no matter what the obstruction is, under the power to regulate commerce it can be removed. In the *Debbs* case this court declared that the same rule precisely applies to artificial highways. After referring to the act of June 15, 1866, which is now section 5258 of the Revised Statutes, and which we have heretofore quoted, it said:

It is said that the jurisdiction heretofore exercised by the national Government over highways has been in respect to waterways—the natural highways of the country—and not over artificial highways, such as railroads, but the occasion for the exercise by Congress of its jurisdiction over the latter is of recent date. Perhaps the first act of such legislation is that heretofore referred to, of June 15, 1866, but the basis upon which rests its jurisdiction over artificial highways is the same as that which supports it over the natural highways. Both spring from the power to regulate commerce.

If thus declared that the basis upon which rests the jurisdiction of the Government over artificial highways is the same as that which supports it over natural highways. This being so, it has the same power to remove obstructions from artificial highways engaged in interstate commerce or in the transmission of the mails that it has over natural highways, such as waterways. Upon this point the court said—

Up to a recent date commerce, both interstate and international, was chiefly by water, and it is not strange that both the legislation of Congress and the cases in the courts have been principally concerned therewith. The fact that in recent years interstate commerce has come to be carried on mainly by rail-

roads and over artificial highways has in no manner narrowed the scope of the constitutional provision, or abridged the power of Congress over such commerce. On the contrary, the same fullness of control exists in the one case as in the other, and the same power to remove obstructions from the one as from the other.

It will be seen that the court again said in terms that the same fullness of control exists as to interstate commerce carried on by railroads or other artificial highways which exists as to interstate commerce when carried on by water.

The court also said—

The National Government, given by the Constitution power to regulate interstate commerce, has by express statute assumed jurisdiction over such commerce when carried upon railroads. It is charged, therefore, with the duty of keeping those highways of interstate commerce free from obstruction, for it has always been recognized as one of the powers and duties of a government to remove obstructions from the highways under its control.

We have given to this case the most careful attention, for we realize that it touches closely questions of supreme importance to the people of this country. Summing up our conclusions, we hold that the Government of the United States is one having jurisdiction over every foot of soil within its territory, and acting directly upon each citizen; that while it is a government of enumerated powers, it has within the limits of those powers all the attributes of sovereignty; that to it is committed power over interstate commerce and the transmission of the mail; that the powers thus conferred upon the National Government are not dormant, but have been assumed and put into practical exercise by the legislation of Congress; that in the exercise of those powers it is competent for the Nation to remove all obstructions upon highways, natural or artificial, to the passage of interstate commerce or the carrying of the mail.

It adjudged that Congress, under the power to regulate interstate commerce, and the power to establish post offices and post roads, may remove all obstructions to the passage of interstate commerce or the carrying of the mails, whether over natural highways or artificial highways. Of course, the court was not speaking of obstructions which a railroad company might itself remove. Obstructions of that nature it is required to remove as a part of its duties. If (as to which there can be no question) the flooding of the Mississippi Valley by the surplus waters of the Mississippi River obstructs inter-

state commerce and the transmission of the mails by means of the railroads running through the valley of the river, Congress has the power to remove that obstruction, and that obstruction can only be removed by confining the flood waters by means of levees. There is no limitation defining what obstructions can be removed and there is no limitation as to the means by which obstructions may be removed. If the method adopted for the removal of obstructions bears any just relation to the power of Congress, what it adjudges by law to be an obstruction and what it adjudges to be a suitable means of removing that obstruction, can not be questioned by the courts or otherwise.

The great extent of the Mississippi Valley has already been indicated. An enormous interstate commerce is now carried on between those who inhabit that valley and those residing in other States, and its capacity for developing still greater interstate commerce is such that at this time no fair limitation can be placed upon it. So as to the business of the Government with those residing in the valley in supplying them with mail facilities and in supplying those residing in other States with the necessary mail facilities for transacting their business with the inhabitants of the valley. The interstate commerce and postal affairs connected with the Mississippi Valley are so great that it may be truthfully said that they are matters of concern to the people of the Nation at large.

It is respectfully submitted that, disregarding entirely all questions as to the navigation of the Mississippi River and all questions arising from the statutes above referred to, conferring franchises upon railroad companies whose lines extend through the valley, and creating them post roads, by which they have been constituted agents of the Government, there must be the power in Congress, under the interstate-commerce clause, to remove the great obstruction to this enormous interstate commerce and this enormous postal business arising from the flood waters of the Mississippi River. In *Gibbon v. Ogden* (9 Wheat., 1), Chief Justice Marshall said—

Commerce undoubtedly is traffic, but it is something more; it is intercourse. It describes the commercial intercourse between nations and parts of nations in all of its branches, and is regulated by prescribing rules for carrying on that business.

In *McCail v. California* (136 U. S., 104), the Supreme Court said—

Commerce includes the fact of intercourse and of traffic and the subject matter of intercourse and traffic. The fact of intercourse and traffic, again, embraces all the means, instruments, and places by and in which intercourse and traffic are carried on, and, further still, comprehends the act of carrying them on at these places and by and with these means. The

subject matter of intercourse or traffic may be either things, goods, chattels, merchandise, or persons.

In *Mobile County v. Kimball* (102 U. S., 691), the court said—

Commerce with foreign countries and among the States, strictly considered, consists in intercourse and traffic, including in these terms navigation and the transporting and transacting of business and property, as well as the purchase, sale, and exchange of commodities.

Although the effect of confining the flood waters of the Mississippi River may result in great financial benefit to the owners of lands and of other property in the Mississippi Valley, yet if the escape of the flood waters does seriously affect this enormous interstate commerce and this enormous postal business, there can be no question as to the power of the Government to preserve it and protect it from destruction, in toto at times, in parts of the Mississippi Valley, and partially with almost every flood, and if this protection can only be afforded by the construction of levees, the power of the Government to construct those levees for that purpose would seem to be beyond question.

If the Government has not this power, then this protection can not be afforded at all except to a very limited extent. The preservation of the valley from the devastation created by these floods calls for some definite system of levee construction which shall operate equally and with the same effect in all parts of the valley. Recognizing this necessity, it is provided by the bill that all money which may be contributed for the construction of levees shall be expended under the direction of the Mississippi River Commission and in such manner as it may require or approve.

All that has been said in this memorandum relates entirely to the question as to the naked power of the Government to make appropriations for the construction of levees. As already stated, the bill authorizes the construction of levees to prevent floods, but it does not declare the purpose which Congress has in mind in seeking the prevention of floods. Therefore, if the appropriations sought should be made and any question should be raised as to their constitutionality, the courts would decline to adjudge that the expenditure of money for the construction of levees is unconstitutional if that expenditure can be made under any power vested in the Government by the Constitution. The purpose of this memorandum is solely to maintain the bill as invoking a power that, under the Constitution, the Government may lawfully exercise.

T. C. CATCHINGS.

MR. BLANCHARD'S ARGUMENT.

I have stated that there was ample constitutional authority for Congress to do this. Let us now examine a little into that question.

An enemy invades us. Our people fly to arms. Points of defense are strengthened. The eye of strategy selects other points to be fortified and defended. Congress votes the money, and immediately long lines of breastworks guard our frontier where attack is apprehended.

But here is an enemy who comes in the form of raging waters, sweeping down in resistless might from the North upon the sunny valleys of the West and South, bringing devastation, destruction, death. He raids through the country, rioting in ruin; and millions, panic-stricken, flee at his approach, leaving their all to be swallowed up in the wild vortex of destruction. The wasting presence lasts but a couple of months, but in that time there has been a destruction of property, present and prospective, equal in value to many millions of dollars.

It is the duty of Congress to say to these people who have so often experienced the disasters of inundation that, even as we would erect breastworks on our frontier to repel the threatened invasion of a warlike foe, so will we build levees along the great river to beat back its surging waters, threatening destruction well-nigh equal to what a human enemy could inflict.

But, it may be argued, the delegation of power to Congress to "repel invasions," "to protect the States against invasion," has reference to a human foe. I grant that is the usual and ordinary meaning or significance given to the term, and it is likely that the framers of the Constitution had in contemplation a human foe when they inserted that clause. The connection, too, in which it is used gives additional weight to that argument.

But still, the power conferred by the words "repel invasions," by the clause "The United States * * * shall protect each of them (the States) against invasion," is a general one, and might well and reasonably include defending the country against danger or harm of any kind.

Suppose some monster, like the fabled dragon of ancient times, were to rise up out of the deep and invade the land, spreading devastation, destruction, pestilence and death around him. Does any one doubt the constitutional power and duty of Congress to "repel" his invasion, to bring the strong arm of the government to bear against him, to make war upon and kill and destroy him? I think not. And yet, sir, there are gentlemen on this floor who deny to Congress the power to "repel" the invasion of waters, to throttle this monster of inundation whose periodical visitation of the fairest portion of our country is but the recurring occasion for a perfect carnival of waste, ruin, rapine.

It is the duty of Congress to protect the States, or any one of them, against invasion. By "invasion" is meant against harm or danger to the government, the people, the country, threatened by an enemy. An enemy is only to be dreaded because of the suffering, destruction, death he may inflict. Judged by that standard, was not the recent great overflow in the alluvial basin of the Mississippi "an enemy"? None will deny its potency as an engine of suffering, destruction and death. Why, then, cannot Congress under this clause of the Constitution protect the Valley States against a recurrence of this "invasion" of waters?

Again, it is made the constitutional duty of Congress to protect each of the States, under certain conditions, against "domestic violence." Why not against the violence of domestic waters? I say "domestic waters" for the reason that it is a fact that all the water which seeks an outlet to the sea through the Mississippi is the drainage of the territory of the United States, and in that sense is domestic, as pertaining to home; not foreign.

REGULATING THE PROPERTY OF THE UNITED STATES.

The Constitution (Article IV, Section 3) provides:

That Congress shall have power to dispose of and make all needful rules and regulations respecting the territory or other property belonging to the United States.

In the Gratiot case (14 Peters, 537) the Supreme Court of the United States, construing the above clause, said:

"The term 'territory,' as here used, is merely descriptive of one kind of property, and is equivalent to the word 'lands.' And Congress has the same power over it as over

any other property belonging to the United States; and this power is vested in Congress without limitation."

In the case of *McCulloch vs. Maryland* (4 Wheaton, 422) the Chief Justice, as the organ of the court, speaking of this clause of the Constitution and the powers of Congress growing out of it, applies it to Territorial Governments, and says all admit their constitutionality.

Story says (volume 2, page 228):

No one has ever doubted the authority of Congress to erect Territorial Governments within the territory of the United States, under the general language of the clause "to make all needful rules and regulations."

He continues:

The power is not confined to the territory of the United States, but extends to "other property belonging to the United States"; so that it may be applied to the due regulation of all other personal and real property rightfully belonging to the United States. And so it has been constantly understood and acted on.

Now, then, if the Mississippi is the property of the General Government, it is as much subject to "regulation" as the landed property or territory of the United States. And this power to regulate includes, curbing, controlling, restraining the river within its own proper metes and bounds by means of levees, dikes or other works, as Congress may, in its discretion, see proper to adopt; for, in the language of the *Gratiot* case, "this power is vested in Congress without limitation."

But it may be denied that the Mississippi river is the property of the United States in the sense that Congress may, under the power to regulate, direct the construction of works to restrain its waters within their proper channel. The Mississippi river is a great national highway.

It belongs as much to the United States as would a great trunk line of railroad that had been constructed, stocked and was being operated by the government. In the act of Congress enabling the people of Louisiana to form a constitution there is a provision that the State convention shall "pass an ordinance providing that the river Mississippi and the navigable rivers and waters leading into the same or into the Gulf of Mexico shall be common high-

ways and forever free, as well to the inhabitants of the said State as to other citizens of the United States." And in the act for the admission of Louisiana the above provision as to the navigation of the Mississippi is made one of the fundamental conditions of the admission. Similar conditions were likewise imposed upon the admission of the States of Mississippi, Missouri and Arkansas.

In the case of *The United States vs. The New Bedford Bridge* (Woodbury & Minots Report, 421), Mr. Justice Woodbury used the following language:

For purposes of foreign commerce and of that from State to State, the navigable rivers of the whole country seem to me to be within the jurisdiction of the general government, with all the powers over them for such purposes (whenever they choose to exercise them) which existed previously in the States or now exist with Parliament in England.

In the case of *Corfield vs. Coryell* (4 Washington Circuit Court Reports, 379) Mr. Justice Washington said:

The grant to Congress to regulate commerce on the navigable waters belonging to the several States renders those waters the public property of the United States for all purposes of navigation and commercial intercourse, subject only to Congressional regulation.

And in the case of *Gilman vs. Philadelphia* (3 Wallace, 724), it was said:

The power to regulate commerce comprehends the control for that purpose, and to the extent necessary, of all the navigable waters of the United States which are accessible from a State other than those in which they lie. For this purpose they are the public property of the nation, and subject to all the requisite legislation of Congress. This necessarily includes the power to keep them open and free from any obstruction to their navigation, interposed by the States or otherwise; to remove such obstructions when they exist, and to provide by such sanctions as they may deem proper against the recurrence of the evil, and for the punishment of offenders. For these purposes Congress possesses all the powers which existed in the States before the adoption of the national Constitution, and which have always existed in the Parliament in England. It is for Congress to determine when its full power shall be brought into activity, and as to the regulations and sanctions which shall be provided.

It cannot, therefore, be doubted that the river, for all practical purposes, is the property of the General Government and subject to its "regulation," whether as respects prescribing rules for governing the commerce and traffic which make use of it as a highway, or as respects controlling it in the sense of denying the dominion and jurisdiction of the States, or other powers; or as respects preventing the river from rising up out of its customary channel and spreading over the country. It is true, the banks of the river and soil under the river belong respectively to the owners of the soil adjacent to the river, but no one will deny to the General Government the right to make use of the banks and soil in the erection of the works requisite to the proper "regulation" of the river for all useful purposes. Should, however, this right be questioned, there can be no doubt of the power of the Government in the exercise of the prerogative of eminent domain, to expropriate whatever may be needed for the proper "regulation" of the river.

The law on this subject is universally recognized, as laid down by Bynkershoek, that "this eminent domain may be lawfully exercised whenever public necessity or public utility requires it."

It may be objected by some that the Federal Government provide the ways and means for the construction of a levee system for the protection of the alluvial valley of the river, and as an adjunct to the improvement of its navigation, inasmuch as these levees will have to be constructed on the banks over which the jurisdiction of the States respectively extend, contention may arise between the State government and the National Government on this point; that the State government might deny the right of the National Government to control the levees, to protect them after constructing them, and that the question thus raised may become a fruitful source of trouble between the sovereignty vested in the State and that reposing in the Federal Government.

I am not one of those who apprehend that any trouble on this score would ever arise, but as a precautionary measure Congress might, if it sees fit, after having determined upon a levee system, enact that there should be no expenditure of money for such purposes within the territorial limits of a State until the State shall have ceded to the National Government the right to control and protect the public works to be constructed.

The State which I have the honor to represent in part in the

Congress of the United States has already led off in that direction. In the constitutional convention of Louisiana which convened in 1879, and which framed the organic law under which that State is now governed, I, as a member of the convention, and as chairman of its committee on Federal relations, acting on the suggestion of Hon. E. W. Robertson, then a representative in Congress from the Sixth district of Louisiana, and chairman of the Committee on Levees and Improvements of the Mississippi of the House, reported to the convention the following ordinance, which was adopted, and now stands as part of article 215 of the constitution of 1879 of Louisiana, to wit:

The Federal Government is authorized to make such geological, topographical, hydrographical, and hydro-metrical surveys and investigations within the State as may be necessary to carry into effect the act of Congress to provide for the appointment of a Mississippi River Commission for the improvement of said river from the head of the Passes near its mouth to the headwaters, and to construct and protect such public works and improvements as may be ordered by Congress under the provisions of said act.

Under this article full authority is given the National Government to construct such public works along the Mississippi as Congress may see fit to order, and the control of the same after their construction is ceded to the National Government.

The State of Louisiana, in incorporating this grant of authority in her organic law, recognized what is now generally conceded, namely, that there is no power competent to handle the question presented by this great river except that of the Federal Government. No State can do it.

First. Because the work is too vast, too costly for any State through which the river runs to undertake it.

Second. Because any State attempting it would be circumscribed by its own territorial limits.

Third. Because the river being the property of the United States, Congress alone has power, under the grant to "make all needful rules and regulations respecting the territory or other property belonging to the United States," to say what works shall be done or plans adopted for its regulation.

POST-OFFICES AND POST-ROADS.

Under the authority "to establish post-offices and post-roads" the Government of the United States has established thousands of the former in the alluvial valleys of the Mississippi and its tributaries, and provided a perfect network of the latter. Daily over thousands of miles of roadway and railway and water way in the great valley is the United States mail carried, supplying innumerable post-offices and affording facilities indispensable for the dissemination of intelligence, for the diffusion of the market reports, the crop and commercial reports, and the news generally so absolutely needed for the welfare, the happiness, and the prosperity of the people and the country.

Millions of money, besides great labor and much valuable time, have been expended in building up and perfecting this system, which in the normal state of the country moves with the precision, ease and regularity of well-ordered machinery. But periodically the great river swells up out of its banks and becomes a great inland sea, producing an abnormal condition of affairs, and disarranging, stopping, destroying for the time being the postal service, the transportation and delivery of the mails.

On our statute-books, as the enactments of Congress, stand stringent penal laws denouncing penalties against any and all who shall willfully impede, interfere with, or stop the mails; and the courts of the United States hold sittings all over the valley to enforce these laws. But here is a great convulsion of nature, as it were, that stops not one mail but a thousand, that breaks up not one post-office but hundreds, and against which the courts and the criminal laws for the protection and security of the mails avail nothing. But to prevent a recurrence of this, is the strong arm of the Government powerless? No. Scientific, wise, experienced men, who have made a study of the river and its phenomena, of the laws of its currents, and of the conditions that affect it, say no! They have pointed out how these destructive floods can be avoided, and thus how the mails of the United States, their carriage and delivery, can be protected.

Now, then, does any one doubt that from the authority, "to establish post-offices and post-roads" flows not only the power but the duty to protect them? No reasonable man can doubt it. No lawyer will hesitate for an instant to declare that the power to

protect is incidental to the power to establish. The constitutionality of the laws denouncing penalties against the stoppage of, or interference with, the mails has never been doubted. Yet they were enacted for the protection of the mails, and depend for their validity upon the power to protect being incidental to the power to establish. Says the Supreme Court of the United States, in 4 Wheaton, 417:

This power is executed by the single act of making the establishment. But from this has been inferred the power and duty of carrying the mail along the post road from one post-office to another. And from this implied power has again been inferred the right to punish those who steal letters from the post-office or rob the mail. It may be said with some plausibility, that the right to carry the mail and to punish those who rob it is not indispensably necessary to the establishment of a post-office and post road. This right is indeed essential to the beneficial exercise of the power, but not indispensably necessary to its existence.

Yet no one doubts or denies the right or power of the government to punish the robber of the mails. Now, then, is it not just as legitimate, just as constitutional, to protect against the ravages of water as against the knavery of the robber?

TO REGULATE COMMERCE.

The power of Congress to regulate commerce includes the regulation of intercourse and navigation (18 Howard, 421).

Says Story, Volume 2, page 4:

Commerce undoubtedly is traffic; but it is something more. It is intercourse. It describes the commercial intercourse between nations and parts of nations in all its branches, and is regulated by prescribing rules for carrying on that intercourse.

This power to regulate commerce is a very general one, and a wide latitude of construction has been given it.

If a levee system tends, in any appreciable degree, to afford ease and safety to commerce, to intercourse which is essential to the carrying on of commerce, then an appropriation of money by Congress to construct such a system finds abundant justification in this grant of power.

The Mississippi River Commission, in their report of February 17, 1880, say regarding levees:

There is no doubt that the levees exert a direct action in deepening the channel and enlarging the bed of the river during those periods of "rise" and "flood" when, by preventing the dispersion of the flood-waters over the adjacent lowlands, either over the river banks or through bayous and other openings, they actually cause the river to rise to a higher level within the river-bed than it would attain if not thus restrained.

They give safety and ease to navigation, and promote and facilitate commerce and trade by establishing banks or landing places above the reach of the floods, upon which produce can be placed while awaiting shipment and where steamboats and other craft can land in time of high water.

* * * In a larger sense as embracing not only beneficial results upon the channel, but a protection against destructive floods, a levee system is essential, and such a system also promotes and facilitates commerce, trade, and the postal service.

To the same effect are the subsequent reports of the Commission and the statements of the individual members thereof before the committees of Congress.

Prior to the act creating this commission a board of engineers was appointed on the improvement of the low-water navigation of the river below Cairo, Ill. In their report to the Chief of Engineers, dated January 25, 1879, on the "effect of a permanent levee system on the Mississippi below the mouth of the Ohio river," they say:

To deal with the question whether there is any connection between levees and facilities for shipping, commerce and navigation at high states, we refer to the actual condition of things. We find that throughout all the extension of the Mississippi along which the levee system is practically efficient, and where the marginal lands are generally cleared and cultivated, the levees have been an important aid to commerce. Below the mouth of the Arkansas, as far down as the forts below New Orleans, the levees have been long enough in existence to give evidence of their effect, direct and indirect. Immediately behind them are the cultivated lands, the plantations whence come sugar, cotton and other valuable staples. To each one of these plantations not only is the levee the protecting agent

which renders their cultivation practicable, but it is during floods the landing-place of the steamboats, barges, or flat boats which bring their supplies and carry their productions away. * * *

In the lower river, through the regions where the margins are under cultivation, the levees are generally laid close to these margins and afford, as has already been stated, useful facilities for commerce in making practicable the coming alongside of steamers and the receiving of the products of the plantations and discharging freights for the use of the same or for the back country. In ordinary rises the natural banks are not overflowed, but when that happens in "flood" years they (the levees) serve a purpose in still defining the channel.

From testimony like this it cannot be doubted that levees aid not only in improving the navigation of the river, but are themselves factors in the giving of ease and safety to commercial intercourse.

If the Federal Government can legitimately spend millions in affording facilities to commerce by improving the low-water navigation of rivers, by parity of reasoning it may just as legitimately spend millions in improving the high-water navigation of rivers like the Mississippi, liable to overflow their banks. And the weight of evidence ten times over is that for the Mississippi and its tributaries a levee system is the most efficient method of improving their high-water navigation.

By the navigation of rivers is meant not alone the passage of steamers and other craft up and down, but in a larger sense it includes likewise facilities for landing along the rivers for the loading and unloading of cargoes, the taking on and putting off of passengers, etc. In other words, it embraces the affording of all needful facilities for intercourse, trade, traffic, and commerce, besides the width, depth, and extent of water requisite for the safe passage of boats.

Again, navigation is only one of the elements of commerce. It is an element of commerce because it affords the means of transporting merchandise and the products of the country, the interchange of which is commerce itself. The river is but an instrument of commerce.

The power to regulate commerce is a power to regulate the instruments of commerce. (Gray vs. Clinton Bridge, 16 American Law Register, 152.)

It extends to the persons who conduct it as well as to the instruments used. (*Cooley vs. Board of Wardens*, 12 Howard, 316.)

The commerce of the river and the commerce across the river are both commerce among the States, and may be regulated by Congress, and should be regulated by that body when any regulation is necessary. (16 American Law Register, 154.)

It is now conceded that Congress, under the commercial clause, may regulate railroads. May it not also regulate the Mississippi, a national highway and an instrument which commerce makes use of, so as to prevent it disturbing the commerce and intercourse going on by rail and by land in its valley?

The term "to regulate commerce" gives the power to restrain the destructive force of the thing used by commerce in its transactions. It is an incongruity to say that Congress, in the exercise of that power, may deepen or enlarge a river but cannot curb its force or exercise restraint over it.

The power "to regulate commerce" necessarily includes protection to commerce. This idea has been acted on from the commencement of the government. The construction and maintenance all along our coasts of light-houses, beacon-lights, fog-signals, sea-walls, and break-waters attest this. All are for the protection and convenience of commerce.

The laws of the United States require steam-vessels to pay for the license or privilege to navigate, and the officers manning such vessels are required to pay for the license or privilege of pursuing their respective calling or vocation, such as master, pilot, mate, etc.

These vessels engage in the coasting trade as well as in carrying trade, and Congress is as much under obligation to afford the needful facilities for the transaction of this coasting trade as it is for the transportation of through freights. One of the facilities needed along the Mississippi for the coasting trade is convenient landing-places at all times.

In seasons of flood, these landing-places are supplied by the levees, and, in this season, levees are but continuing piers or quays. A quay is defined to be a space of ground appropriated to the public use, such use as the convenience of commerce requires. Now, while the levees perform this service, while they furnish these

needed conveniences to commerce, should it be objected that, at the same time, they protect the country behind them from overflow? Suppose they do protect private property while performing a public service, should they not be commended all the more for that? Should not that circumstance really be an additional inducement or argument for their construction?

Should not broad and liberal statesmanship, in considering a question of this sort, rather approve of a system which, while subserving the public interests, at the same time affords needed protection to the life and property of the individual? *Salus populi suprema lex*. Protection to private property in some way results from nearly every work of public import. If a street in a town or city be graded, paved or macadamized, the property belonging to individuals on that street experience an enhancement of value as the result of such improvement.

Every railroad constructed through a country increases the value of the lands adjacent thereto. Every grand, imposing public building erected in this city (Washington), and every park laid out, beautified, adorned, adds something to the worth of neighboring private estates.

This question of regulating the Mississippi certainly comes within the general police power of the government, under which power "persons and property are subjected to all kinds of restraint and burdens in order to secure the general comfort, health and prosperity of the state." (27 Vt., 149; quoted approvingly in 5 Otto, 471.) In the latter case the Supreme Court, speaking of the deposit in Congress of the power to regulate Commerce, say:

What that power is it is difficult to define with sharp precision. It is generally said to extend to making regulations promotive of domestic order, morals, health, and safety. As was said in *Thorp vs. The Rutland and Burlington Railroad Company*, 27 Vt., 149, it extends to the protection of the lives, limbs, health, comfort and quiet of all persons, and the protection of all property within the State. According to the maxim, *Sic utere tuo ut alienum non laedas*, which, being of universal application, it must of course be within the range of legislative action to define the mode and manner in which every one may so use his own as not to injure others.

If the government fails to exercise its police powers to control its property, and this property, like a great river, rises and inun-

dates the country, and great damage to individuals results, the government is, or ought to be responsible.

Take the case of an Indian tribe placed by the government upon a reservation, and over which it exercises jurisdiction and surveillance. From some cause an outbreak occurs. The Indians throw off the restraint they are under, band themselves together, commence hostilities, and raid the surrounding country. For the damage and loss occasioned individuals by such an outbreak the government has repeatedly acknowledged its liability, and Congress has over and over again appropriated money to make good such losses.

Now, why should it not be equally responsible for losses occasioned by the Mississippi when it, in time of flood, raids the adjacent country? The government not only assumes paramount jurisdiction over the river, but asserts a proprietary interest in and to it.

Why, then, should it not be under obligations to restrain and control it, equal to the restraint and control it admits it should exercise over an Indian tribe placed by it under a reservation?

If a railroad train kills the stock of a man a suit lies to enforce payment of the value of the stock from the company. But the great Mississippi rises, and, by the neglect of the government to protect its banks by dikes, overflows, causing the destruction of millions in value of property. No suit against the Government can be filed, for this great and free Republic does not permit what the veriest despotisms of foreign lands allow, namely, the general right to its citizens to sue the Government in any court of competent jurisdiction for injuries sustained by the act of commission or omission of the Government.

The first clause of section 8, article I, of the Constitution prescribed that "Congress shall have power to lay and collect taxes, duties, imposts, and excises, to pay the debts and provide for the common defense and general welfare of the United States."

I agree with the interpretation that the above clause was not intended to invest Congress with the independent and general power "to provide for the general welfare;" and that the latter part of the clause, to wit, "to pay the debts and provide for the common defense and general welfare," is but a modification or qualification of the preceding part, namely, "Congress shall have power to lay and collect taxes," etc.

Nothing more was granted by that part ("to pay the debts and

provide for the common defense and general welfare") than a power to appropriate the public money raised under the other part, ("To lay taxes,") etc.

Said Thomas Jefferson:

To lay taxes to provide for the general welfare of the United States is to lay taxes for the purpose of providing for the general welfare. For the laying of taxes is the power and the general welfare the purpose for which the power is to be exercised. Congress are not to lay taxes *ad libitum* for any purpose they please; but only to pay debts, or provide for the welfare of the Union.

Under this interpretation, while a general power to legislate for the "general welfare" is excluded, Congress is still authorized to provide money for the common defense and general welfare, and this is quite broad enough for the practical purpose we have in view. Indeed, the power to lay taxes is in express terms given to provide for the common defense and general welfare. And, as laid down by Story:

It is not pretended that when the tax is laid the specific objects for which it is laid are to be specified, or that it is to be solely applied to those objects.

It suffices that all taxes must generally be laid for one or all of three purposes, namely, to pay the debts, to provide for the common defense, or the general welfare. And when the money has accumulated in the Treasury, from taxes laid for any or all of these purposes, as said by President Monroe in his message of May 4, 1822:

The power of appropriation of the moneys (by Congress) is coextensive; that is, it may be appropriated to any purpose of the common defense and general welfare.

In other words, if operating under the latter clause, the taxes laid must be applied to some particular measure conducive to the general welfare. Or, as laid down by Story, volume 2, page 162:

The only limitations upon the power (to appropriate money in aid of internal improvements) are those prescribed by the terms of the Constitution, that the objects shall be for the common defense, or the general welfare of the Union.

The true test is whether the object be of a local character and local use, or whether it be of general benefit

to the States. If it be purely local Congress can not constitutionally appropriate money for the object. But if the benefit be general it matters not whether in point of locality it be in one State or several, whether it be of large or of small extent; its nature and character determine the right, and Congress may appropriate money in aid of it, for it is then in a just sense for the general welfare.

It is not only right, but the bounden and solemn duty of Congress to advance the safety, happiness and prosperity of the people, and to provide for the general welfare by any and every act of legislation within constitutional limits, which it may deem to be conducive to those ends. No one will have the temerity to question the proposition that the protection of the extensive alluvial valley of the Mississippi from destructive floods will be, in the national sense of that term, conducive to the general welfare. Not one State, but a dozen; not a few thousand people, but millions, are directly interested and affected for weal or woe according as this protection is extended or withheld. One overflow, as hereinbefore stated, has caused the destruction of many million dollars worth of property, without taking into consideration the human and animal suffering and death inflicted by it. Does any sane man doubt that providing against the recurrence of such a public calamity is promoting the general welfare?

But it is unnecessary to dwell upon this. The point is conceded. No man of reflection will gainsay that if it were to the general welfare that we should acquire this territory, as we did, from France, it is equally conducive to the general welfare to preserve it as a habitable, cultivable country; to protect it against relegation to its primeval condition of jungles and swamps. The words of Chief-Justice Bigelow, of Massachusetts, in the case of *Talbott vs. Hudson*, 24 Law Reports, 228, are here singularly appropriate:

In a broad and comprehensive view * * * everything which tends to enlarge the resources, increase the industrial energies, and promote the productive power of any considerable number of the inhabitants of a section of the State (Union), or which leads to the growth of towns and the creation of new sources for the employment of private capital and labor, indirectly contributes to the general welfare and to the prosperity of the whole community.

Congress has exercised, not without question, it is true, but long enough for acquiescence to take place, the power to lay taxes to protect and encourage domestic manufactures.

This has been and is being done, on the ground that it is conducive to the general welfare to protect and encourage domestic manufactures. But it is not one whit more conducive to the general welfare, if as much so, than protecting the finest portion of our country for cultivable purposes is.

All must admit that the powers of the Government are limited and that its limits are not to be transcended. But, as was observed by the Supreme Court of the United States in 4 Wheaton, 421, the sound construction of the Constitution must allow the National Legislature that discretion, with respect to the means by which the powers it confers are to be carried into execution, which will enable that body to perform the high duties assigned to it in the manner most beneficial to the people.

Let the end be legitimate, let it be within the scope of the Constitution, and all means which are appropriate, which are plainly adapted to that end, which are not prohibited, but consist with the letter and spirit of the Constitution, are constitutional.—*Ib.*

In *McCulloch vs. Maryland* (4 Wheaton, 415) Chief-Justice Marshall aptly referred to the Constitution as "intended to endure for ages to come, and consequently to be adapted to the various crises of human affairs."

And in *Hunter vs. Martin* (1 Wheaton, 304) it was said:

The instrument (Constitution) was not intended to provide merely for the exigencies of a few years, but was to endure through a long lapse of ages, the events of which were locked up in the inscrutable purposes of Providence. It could not be foreseen what new changes and modifications of power might be indispensable to effectuate the general objects of the charter. * * * Hence its powers are expressed in general terms, leaving the Legislature, from time to time, to adopt its own means to effectuate legitimate objects, and to mold and model the exercise of its powers as its own wisdom and the public interests should require.

Then the great Father of Waters, unhindered by an adequate levee system, rises out of its banks and sweeps with resistless might

over the valley, a more than crisis, a sad realization of the worst, 's upon the people of that unhappy section, and this grievous affliction of one of the members of the body-politic in more or less degree disastrously affects the whole. Against the recurrence of the like calamity, national in its effect, we ask the aid of the National Government. We hold that the powers delegated in general terms in the Constitution are broad and comprehensive enough to justify it, that the granting of national aid for such purpose is directly in the line of the effectuation of the legitimate objects of the charter.

Says Story (Volume I, page 655) :

Constitutions of governments are not to be framed upon a calculation of existing exigencies, but upon a combination of these with the probable exigencies of ages, according to the natural and tried course of human affairs. There ought to be a capacity to provide for future contingencies as they may happen.

That this capacity exists in the Federal Constitution no one will deny. The trials it has undergone, the tests it has been put to and triumphantly emerged from, in the hundred years of its existence, abundantly attest it. Let Congress give another evidence of this capacity by providing against the contingency of another great overflow; let this provision be ample and unrestricted; let it meet the case.

APPENDIX A.

FLOOD CONTROL OF THE MISSISSIPPI RIVER.

Address by Col. C. McD. Townsend, United States Army, at Memphis, Tenn., September 26, 1912.

Mr. President and gentlemen, when such a disaster occurs as has swept over the Mississippi Valley within the last few months, it arouses the intellectual activity of our people, and many suggestions are made of the means of preventing its recurrence.

As president of the Mississippi River Commission, I have received numerous communications, some addressed to the President of the United States, the Secretary of War, or the Chief of Engineers, attempting to explain the causes of this great flood, or giving the writer's views of the mistakes which have been made by the Mississippi River Commission in handling it.

The Mississippi River Commission has explained with great detail in its reports its reasons for relying on levees for protecting the country from overflow, but they appear to be unknown, not only to the country at large but to many who reside in the Mississippi Valley and are most vitally interested in the problem.

I therefore consider it proper to appear before you, accept the invitation of the illustrious speaker who preceded me, and state briefly reasons for rejecting the various methods of flood control other than levees, which have been suggested. As a full discussion of any one of the propositions would prolong my remarks to such an extent as to tax your patience, I can only touch upon the subject, and I have confined myself to stating not what I considered the most logical argument for the engineer, but the reason most evident to the general public for rejecting a proposition.

ABANDONMENT OF LEVEES.

Many persons in the United States—some even in the Mississippi Valley—argue that as the heights of floods have increased as the land has been reclaimed, this is sufficient evidence that there are no limits to the heights which the river will reach, and that levees should therefore be abandoned, mounds constructed to preserve cattle and other farm animals during the floods, and the cultivation of the country confined to such periods as there is no overflow. Such critics point to the Nile as an example, and argue that as this method of handling the Nile has been successful, it should be applied on the Mississippi.

I shall discuss the question of levee heights later, but desire at the present time to particularly invite attention to the dangers which result from comparing one river with another without familiarity with the conditions that exist on both.

It is unquestionably true that the flood waters of the Nile have for ages been permitted to spread over its valley with beneficial results, but it by no means follows therefrom that other rivers should be similarly treated.

The Nile rises near the Equator, and flows from a tropical toward a temperate zone. This characteristic differentiates it from most of the other large rivers of the world. Its floods arise from tropical storms during the early winter months, which reach its mouth early in the spring. It therefore deposits its silt on the land and subsides before the agriculturist is prepared to plant his crops. In fact, as there is little rain in the Nile Valley, it is impossible for the crop to grow until the river overflows.

The conditions on the Mississippi are the reverse. Its sources are in the ice-bound North, and it flows toward the Tropics instead of away from them. The snows at some of its sources are beginning to melt when the floods of the Nile have reached the sea. Bounteous rains occur in the lower valley, and the crops are therefore well advanced before the flood arrives. The floods of the Nile prepare the land for the farmer, while those of the Mississippi destroy the crops he has planted.

An occasional flood from the Cumberland and Tennessee Rivers may flow down the river and subside in time to allow planting after it has passed, but the usual flood from the Ohio River, and any flood from the Missouri or upper Mississippi Rivers arrives so late that it is impracticable to raise cotton or sugar cane after it subsides.

As Judge Taylor has observed, if the river was allowed to disperse its waters freely over the whole alluvial plain, the overflow would be shallow, and low mounds would suffice for refuge during floods where the inhabitants could wait in safety for the waters to subside.

Men have lived and could live again under such conditions, but not comfortably, according to modern ideas. Such abandonment of all attempts at control of the river would leave it free to work its own will on its banks. It would wander hither and thither around sand bars which it had built from material taken from its caving banks and which it would be unable to remove. It would behave as it did in the ages when it was building the alluvial valley. The same law of sedimentary deposit which obtained then would be present and controlling. A narrow margin of land adjacent to the overflow would be built up, beyond which would stretch interminable swamps filled with water. No intelligent man can entertain seriously such a proposal as this.

REFORESTATION.

Judging from my correspondence, it would appear that there exists in the public mind an impression that the prime cause of floods in this country has been the destruction of the forests, and that the surest way to prevent them is by reforestation. The subject of the influence of forests on stream flow is not unknown to the river engineer. It has been extensively discussed both by European and American engineers since Gustav Wex, imperial and ministerial counselor and engineer of the improvement of the Danube River at Vienna, in 1873, submitted a series of papers on the decrease of water in springs, creeks, and rivers, which were translated into English by the late Gen. Weitzel, of the Corps of Engineers.

There is a great diversity of opinion on the subject, some maintaining that the cutting off of forests will ultimately convert Europe into a Numidian desert, while others claim that a moderate cutting of the forests even increases the rainfall. Whatever may be the theoretical principles involved, their practical application to the lower Mississippi River is fraught with great difficulty.

When a country acquires a population of nearly 100,000,000 people, the forest primeval which existed when it was first settled has to disappear. It is all very well to bemoan the fact that if the black walnut which once covered the State of Ohio had not been destroyed and was sold as lumber at the present market rates it would equal the assessed valuation of the property of the State, but there have now been created the cities of Cleveland and Cincinnati, whose people cannot live on black walnuts alone, but require grain and meat. The black walnut of Ohio has gone never to return, and it is the same in other sections. The fertile lands will not be taken away from the farmer. They are too valuable for raising potatoes and hogs. Only the poorer soils can be used for forest culture, and only a limited reforestation then is possible. It is therefore ridiculous to expect any better results in reference to floods from reforestation than existed before the forests were destroyed. While our official gauge records do not in general extend back much more than 40 years, yet on several of the western rivers we have records of the heights of floods extending over a century. Thus at St. Louis there is a flood recorded in 1844, having a height of 41 feet on the gauge. The next highest flood, in 1785, was over 40 feet. At Cincinnati in 1832 there was one of 64 feet. It is needless to explain to this audience that a flood of such heights in either the Ohio or upper Mississippi would mean ruin to the plantations below Cairo if there were no levees to protect them.

It is, however, argued by some that with reforestation if the floods occasionally were high they would not be as frequent. Again let us search the records of the past. It is hopeless by reforestation to expect to reproduce the forest growth that existed at the close

of the Civil War. Yet from 1857 to 1867 was a most remarkable series of great floods, occurring as frequently as any that have been recorded since that time.

RESERVOIRS.

Next to reforestation, reservoirs as a means of controlling floods appears to have the most advocates. The reservoir theory is particularly attractive, as we have before us in the Great Lakes a practical illustration of flood restraint by means of natural reservoirs. Reservoir control of the Mississippi River was discussed by Humphreys and Abbot in 1858, and on the upper Mississippi the Corps of Engineers has constructed the largest system of reservoirs for regulating rivers that has been built in any country, having nearly twice the capacity of those proposed by the Pittsburgh flood commission for controlling floods at Pittsburgh. These reservoirs have been most successful, not only for increasing the low-water discharge of the Mississippi River above St. Paul, the purpose for which they were constructed, but also for reducing floods in that portion of the river.

There is therefore nothing novel to the river engineer in the proposition to control rivers by reservoirs. We have not only studied its advantages, but we know its limitations. Conditions are extremely favorable for reservoir construction at the headwaters of the Mississippi, but while they materially increase the low-water discharge at St. Paul and markedly reduce flood heights, yet 100 miles farther down the river it is impossible to detect their influence during either high or low water.

A reservoir must be close to the locality to be benefited or its value rapidly diminishes, and this is a serious trouble with any project for regulating the lower Mississippi by reservoirs.

The material which is eroded from our hills is carried down by our rivers and deposited during floods on the lowlands of the lower reaches, making them the richest agricultural portions of our country. They become highly cultivated, buildings and fences are constructed, towns spring up and are connected by highways and railroads. Railroad wrecking is a rather popular amusement at present, so I omit their relocation from the discussion; but the engineer had better beware of that horny-handed son of toil, the American farmer. He is not going to consent to be driven from the rich alluvial valley to the less fertile hills, and is going to protest most vigorously against structures which will cover his fields with water from 150 to 200 feet deep. As he has votes, it is going to be necessary to listen to him, and the dams must be moved back to the mountain streams where land is of little value. This renders necessary the construction of the reservoirs to control the Ohio River on the upper branches of the Allegheny, Monongahela, and other tributaries, over 1,000 miles from its mouth. Those on the upper Mississippi will also be about

1,000 miles from Cairo, and those on the Missouri over 2,000. These are too great distances for the proper regulation of any stream. Moreover, such a project leaves too large a proportion of the watershed unprotected to be effective. In fact, the flood of 1912 was caused by rains in that portion of the valley which would be without reservoirs. It was not the melting snow at the sources, but rains in midstream areas that created the damage. Neither at Cincinnati, St. Louis, Chattanooga, or Nashville were flood heights excessive.

I have recently been appointed a member of a board to investigate the use of reservoirs to protect the city of Pittsburgh from overflow. The Pittsburgh flood commission has a carefully prepared project which proposes to store in 17 reservoirs 59,000,000,000 cubic feet of water at an estimated cost of about \$21,000,000, which I consider very reasonable. Fifty-nine thousand million is a pretty large looking figure, but I made a little computation to see what it meant when translated into a unit applicable to the Mississippi River, and found that during less than seven hours 59,000,000,000 cubic feet of water flowed by the latitude of Red River at the crest of the recent flood, and, based on the estimate of the flood commission, it would therefore require over \$73,000,000 to build reservoirs that would hold the water that passed down the river in one day. The cost of storing one day's flow is ample for all the levee construction required on the river, while its reliance is placed on reservoirs, provision must also be made for the other 48 days the river was above a bank-full stage.

CUT-OFFS.

Another favorite method suggested for reducing flood heights is by means of cut-offs. The Mississippi River Commission in numerous reports has called attention to the injury which would result from cut-offs, the increased caving which is caused thereby, and the damage to navigation during low water. These may be thought by some theoretical considerations. I desire to invite attention to the fact that cut-offs have been repeatedly tried in Europe as a means of reducing floods, but always with disastrous results. The most noted example is the river Theiss in Hungary.

This river originally had a very gentle slope, about equal to that of the Illinois River below La Salle. It was leveed with the same results which always obtain when rivers are confined—the heights of its flood increased. It was then proposed to shorten the river by cutting off the bends and thus giving it a deeper slope. The project was carried out, but the first great flood that occurred after the work was completed rushed through the improved section much faster than the lower part of the river could carry it off. Flood heights were lowered, to be sure, at the upper end, but correspondingly increased at the lower, and in 1879 the town of Szegedin was destroyed by the flood.

At the Canal de Miribel on the Rhone a similar method was tried, with similar results. At the upper end of the reach both the high water and the low water planes were lowered, with great damage to the low-water navigation, while at the lower end they were raised, producing increased flood heights and also injury to the low-water channel. A cut-off affords relief at one locality, but at the expense of another.

OUTLETS.

Outlets have been suggested as another means of relief, and the Mississippi River Commission has frequently discussed the inadvisability of outlets and waste weirs as a means of lowering flood heights. I differ with some of my conferees on this subject, but rather in the line of argument than in results. Where the river has depths exceeding 100 feet, as in the vicinity of New Orleans, I am of the opinion we could afford to permit a moderate diminution of river depths if thereby we could obtain a material reduction of levee heights. I also believe that the effect of outlets in reducing flood heights is not as great as is popularly supposed. The last flood, however, clearly demonstrated that wherever there was a large crevasse, which is but another name for an outlet, the river ceased to rise. Such outlets were not entirely satisfactory to the planter whose land was behind them. And another lesson to be derived from this flood is that if you are going to reduce flood heights by this means, you must also control your outlet, i. e., it will require a levee system of the same height as that of the main river, and the amount that is saved in the height of the levee line will not compensate for the extra length it is necessary to construct and maintain.

Another serious objection to an outlet is the difficulty in regulating the velocity with which the water will flow through it at varying heights of the main stream. If it is so constructed that it will discharge at a greater velocity than the river itself, there is danger of its enlargement to such an extent as to divert the greater part of the flow down it, and transfer the main stream itself into an outlet; and if, on the other hand, it discharges at a lower velocity, it will tend to fill with sediment.

THE EFFECT OF LEVEES ON RIVER BED.

There is considerable confusion in the public mind in reference to the effect of levees on the river bed, some believing that they cause the bed to scour out, while others are equally as positive they cause the river bed to rise.

The motion of sediment in a silt-bearing stream is not clearly understood, even by many engineers who write on river hydraulics.

In such a stream there are certain sections called pools, which

are usually found in the bends. These are separated by shallower sections which are called bars.

When the river is low the velocity with which the water flows through the pools is less than that with which it flows over the bars, and there is a tendency for the channel over the bars to scour out and the material eroded to be deposited in the pool below. As a river rises the velocity in the pools increases more rapidly than on the bars, and a period soon occurs when there is a greater scour in the pools than on the bars, so that the bars begin to rise and the pools to deepen. When the river falls the velocities in the pools decrease more rapidly than on the bars, and there is a reversal of the process—the bars deepening and the pools filling up. This action is modified by a movement of sand waves down the river and by a centrifugal force which results from the piling up of water in the bends, but it occurs in all alluvial streams which flow with sufficient velocity to scour their beds, whether they are leveed or not. Levees may, to a certain extent, intensify this action, but they will not materially change it.

With such constant mutations the only way to determine whether the river bed is rising or being scoured out is by comparing corresponding low waters with each other, or corresponding high waters.

Several hundred years ago a French traveler visited Italy, and on his return reported that levees had raised the bed of the Po River. His statement was carefully investigated and found to be untrue, but, like Wex's assertion that the cutting of forests has injured river beds, it has traveled over the whole world where rivers have been improved, and vexed the engineer in charge of their improvement.

The French engineers have made careful investigations of the leveed rivers of France and found no evidence of such action. The Germans have studied the Rhine and the Austrians the rivers of Austro-Hungary and failed to detect it. The Mississippi River Commission has made similar observations of the Mississippi River and found more evidences of a scour than of a fill. In no case has it been observed that the effect of levees to raise the river bed was more than a few tenths of a foot in a hundred years, and may be termed a geological effect resulting from the lengthening of the river as it deposits its silt at its mouth. The assertion is now admitted to be false on the main rivers of all civilized countries which are capable of being studied, but it is still claimed that it is true in China and Japan. I recently visited Japan and had an opportunity to further investigate the subject. On the larger rivers, like the Osaka, there were no evidences of any such action, but in mountain streams which flow down steep hillsides and suddenly change their slope when they pass through plains, as is the case with a number of streams which empty into Lake Biwa, the upper portions of the streams have been scoured out, forming deep gullies, and the material thus eroded deposited at

the foot of the hills. The same conditions exist on the mountain streams which empty into the Mississippi that are not leveed, but the eroded material has an opportunity to spread over a greater area at the foot of the hills and is therefore not as perceptible.

My own view of the effect of levees on stream flow is that they tend to remove irregularities and make the slope more uniform. If a cutt-off should occur, disturbing the river's regimen, they would tend to cause the river to return more quickly to its normal slope, raising those bars which had been unduly lowered and scouring out those which were abnormally high. They should also, to a certain extent, enlarge the river section, but at a rate so low that it would be a question of practical importance to those who will inhabit the valley in the twenty-fifth century, rather than those who are tilling it today.

LEVEE HEIGHTS.

While there is no evidence that the bed of the Mississippi River has risen from levee construction, it is apparent that flood heights have greatly increased in the last 20 years.

When the Mississippi River Commission was formed there existed two schools of engineers—one that believed if the river were leveed it would scour out so that a large increase in flood heights would not occur; the other that there would be little enlargement of the river section, and that flood heights should be computed without regard thereto.

There was considerable discussion of those propositions, both by the commission and the general public, and the general public was very strongly opposed to the theory that high levees were necessary.

I take the liberty of recalling that about 20 years ago I submitted a paper to prove that if the St. Francis Basin were leveed a flood like that of 1882 would attain a height at Helena of at least 54 feet. I was forthwith charged with being an enemy of the levee system. A state of the public mind existed similar to that which arose in Louisiana at the commencement of the recent flood, when I intimated that there was danger to the levees of that State. I do not recall that any demands were made for my removal, but it was suggested to the commission that investigations by subordinate officers be discouraged.

Under these conditions it was necessary for the commission to establish a grade line for levee construction, and they announced a provisional grade, which was neither as low as many persons considered ample, nor as high as others thought necessary. This grade was generally accepted as a line to build to, the ultimate grade to which levees were to be constructed to be afterwards determined by observation.

This was a most happy solution of the problem, as was forcibly demonstrated during the last flood, during which less than 1 per

cent of the length of the levee line was destroyed. The engineer must always bear in mind that he must make the best use that is possible of the funds with which he is entrusted. If the ultimate grade line which this flood shows is necessary had been adopted, it is true that many miles of levee would have been held with comparatively little effort, as was the case in the upper Yazoo district, but to attain such a result the funds which would have been expended in constructing them would have been taken from the remainder of the levee line, which would have been necessarily weakened thereby, and crevasses would therefore have been much more frequent.

In fact, if it could be predicted that the next great flood would be similar to the last, even a somewhat lower provisional grade line would be desirable in certain portions of the river, as 586 miles of levees have not been constructed to this grade, and some 53,000,000 cubic yards must be placed in them to create the cross section which has been adopted by the commission. But no two floods are similar. The grade line established by this flood will be subject to material changes, arising from variations in the discharge of the White, Arkansas, and Red Rivers, or even from local rains.

There is appended a table which gives the heights attained by the river at various localities during the last flood, the previous highest waters, the provisional levee grade, and the estimated high water during the flood of 1912 if no crevasses had occurred. It will surprise many to learn that at none of the stations in the table the flood of 1912 reached a height equal to that of the provisional grade line, nor did a crevasse occur in any levee that was built to the grade and given the cross section established by the commission, except possibly at Hymela.

If the recommendations of the commission, made some 15 years ago, had been carried out, this disaster, to a large extent, would have been averted. I do not mean to imply by this statement that the provisional grade adopted by the commission is the ultimate grade to which levees should be constructed; in fact, they must ultimately be built at least from 2 to 3 feet higher; but that if the provisional grade and cross-section had existed throughout the valley, wherever the flood attained a height greater than the provisional grade, there would have been a good fighting chance to hold the levees by topping, while with defective foundations and weak section, the battle was lost before the river could attain that height.

As a result of this flood the commission does not recommend any immediate change in its provisional grade; on the contrary, it is of the opinion that the first work to be done is to strengthen the foundations wherever any weakness has been observed, then to bring the section to standard dimensions. When the levee line is uniformly perfected to the provisional grade, its further enlargement will be

advisable. Excessive strength in one locality with the necessary undue weakness at others should be avoided.

CAVING BANKS.

While about 2,500,000 cubic yards of the levee line were destroyed by crevasses during the last flood, over 4,300,000 cubic yards had to be abandoned during the past year on account of caving banks. The loss from crevasses is considered a national calamity, while that from caving banks is scarcely noticed. But I desire to particularly invite attention to the drain upon the community this caving of levees into the river has become. It requires an expenditure of nearly \$1,000,000 annually to replace them. The Mississippi River Commission appreciates the relief that Congress has afforded them by its proviso that \$4,000,000 of the \$6,000,000 appropriated by the last rivers and harbors bill must be expended on levees. It precludes the use of any funds for the protection of city parks or even city fronts. But there is a danger from too close a limitation of the powers of the commission. It frequently is cheaper to construct a bank revetment than to rebuild a levee which is caving into the river. I apprehend that under the present act several hundred thousand dollars will be wasted. Because of its limitations levees must be constructed where bank revetments are more desirable.

FOUNDATIONS.

The advice which the commission has received on the use of concrete, steel piles, triple-lap sheet piling, and other patent inventions for levee construction, would fill a large volume. I will not detain you with a discussion of these devices further than to state that we are convinced from the results of the late flood that greater care must be exercised in securing the levee foundations, but whether this result will be attained by an enlarged muck ditch, a wall of concrete or sheet piling, or other means, is dependent so much on local conditions that no general plan can at present be formulated.

CONCLUSION.

The flood of 1912 affords no argument for the abandonment of levee construction. It has simply attained the height which Gen. Comstock and Maj. Starling predicted the flood of 1882 would have attained if the river had then been confined. It has cleared the atmosphere of certain false theories, and we can now resume operations with a definite knowledge of the problem before us. We are passing through the same experience European nations have had.

Levees have been tested for ages and have proved uniformly successful when built of adequate dimensions. During the progress of construction there were disasters on foreign rivers as well as in the United States. No other method of relief from floods has been successfully applied to large streams.

Originality is a very desirable quality in an engineer, but there is danger of confusing originality and ignorance. When a proposition with which he is unfamiliar is presented to him it is his duty to follow the instructions placed at some railway crossings, to stop, look, and listen. He should investigate what has been done in the past, and seek to discover if there is no precedent for his action.

It was said several thousand years ago that there is nothing new under the sun. The saying is true to-day. To adopt a project, even though popular, that has been tried, found wanting, and rejected by our forefathers, is not progress, but retrogression.

Table of gauge readings of flood heights and provisional grades, Mississippi River, Cairo to Fort Jackson.

Name of gauge station.	Miles below Cairo.	High water 1912. ¹		Previous highest water and year.		High water, 1912, compared with previous highest.	Estimated high water for confined flood, 1912. ²	Provisional levee grade.	High water, 1912, below provisional levee grade.
		Date.	Gauge reading.	Feet.	Year.				
			<i>Feet.</i>			<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>
Cairo, Ill.....	0.0	Apr. 6, 7.....	53.95	52.17	1883	+1.78	55.0	55.20	1.25
Columbus, Ky.....	21.6	Apr. 5.....	49.00	45.58	1883	+3.42	49.7	51.30	2.30
New Madrid, Mo.....	70.3	..do.....	44.11	40.27	1897	+3.84	44.6	45.60	1.49
Cottonwood Point, Mo.....	122.5	Apr. 11-13.....	42.04	39.96	1903	+2.08	43.0	44.30	2.26
Fulton, Tenn.....	175.4	Apr. 9.....	43.31	40.15	1903	+3.16	44.0	44.60	1.29
Memphis, Tenn.....	230.0	Apr. 6.....	45.20	40.30	1907	+4.90	48.5	45.60	.40
Mhoon Landing, Miss.....	276.3	..do.....	44.90	42.20	1907	+2.70	47.0	46.80	1.90
Helena, Ark.....	306.5	Apr. 22.....	54.30	51.75	1897	+2.55	55.5	56.10	1.80
Sunflower Landing, Miss.....	352.7	Apr. 15.....	50.85	48.00	1903	+2.85	53.0	52.20	1.35
Mouth of White River, Ark.....	393.2	Apr. 16.....	56.35	53.70	1903	+2.65	58.9	57.70	1.35
Arkansas City, Ark.....	438.3	Apr. 12.....	55.35	52.90	1903	+2.45	57.5	56.90	1.55
Greenville, Miss.....	478.3	..do.....	50.75	49.10	1903	+1.65	52.8	53.10	2.35
Lake Providence, La.....	542.3	..do.....	48.11	46.48	1903	+1.63	50.7	50.48	2.37
Vicksburg, Miss.....	599.3	..do.....	51.65	52.48	1897	-0.83	55.0	55.80	4.15
St. Joseph, La.....	648.3	Apr. 13.....	48.60	48.07	1903	+0.53	51.0	52.80	4.20
Natchez, Miss.....	700.3	Apr. 13, 17.....	51.40	50.35	1903	+1.05	54.5	56.00	4.60
Red River Landing, La.....	765.3	May 11, 12.....	53.20	50.20	1897	+3.00	54.5	54.50	1.30
Bayou Sara, La.....	799.8	May 11.....	47.20	43.70	1897	+3.50	48.5	47.70	.50
Baton Rouge, La.....	833.3	May 11, 13.....	43.80	40.65	1897	+3.15	45.1	45.20	1.40
Plaquemine, La.....	854.1	May 11.....	39.38	36.25	1897	+3.13	40.7	40.70	1.32
Donaldsonville, La.....	885.4	May 10.....	35.10	32.75	1897	+2.35	36.0	38.95	1.85
College Point, La.....	904.5	May 11.....	30.23	27.95	1897	+2.28	31.4	31.80	1.57
Carrollton, La.....	957.0	..do.....	21.05	19.42	1903	+1.63	22.2	23.00	1.95
Fort Jackson, La.....	1,039.0	May 3, 4, 7, 11..	8.28	8.27	1907	+0.01	9.0	11.00	2.72

¹The high water of 1912 is the highest known for all stations on the Mississippi River from Cairo down, except at Vicksburg, Miss.

²The estimated high water for the 1912 flood confined is deduced from the data now available, and may be modified by further experience.

THE PROBLEM OF THE MISSISSIPPI RIVER.

Editorial Scientific American, February 15th, 1913.

The great flood of the Mississippi River of last year—the largest in recorded history—when the levees were overtopped or carried away bodily, and vast areas of the valley were inundated, has created a doubt in the minds of the public as to whether the method of control by revetment and construction of levees was not a failure. This doubt has been freely expressed in the many letters which have been published during the past year in the columns of the *Scientific American*. We have made no comment upon these letters, many of which suggested alternative and supposedly better plans for the control of the river, and our silence has been due to the fact that we were making a study of the problem from every possible source of information, with a view to determining for ourselves whether the present plans for the control of the river, or some other, were the best to apply in grappling with and controlling this stupendous problem.

We have come to the conclusion that the present plan of the Army Engineers of protecting the banks of the river by revetment and raising the banks by artificial levees to a sufficient height to prevent overflow is not only the best way to control the river, but the only way.

If it be asked whether the disastrous inundation of last year does not spell failure, we answer emphatically, "No." The inundation occurred, not because the plan was faulty, but because it was incomplete. It was also due to the fact that the existing levees were built only to a sufficient elevation to control the highest flood on record, which the flood of last year greatly exceeded—the maximum flow reaching the enormous total of 2,300,000 feet per second, or 12 times the amount of water that passes over Niagara Falls.

The trouble with the Mississippi work is not that the plans are wrong, but that they have been carried out piecemeal, and in a somewhat happy-go-lucky manner. The Nation should apply to this great work the lesson which it has learned at Panama. A new grade line for the summit of the levees should be established, said line being well above the height reached by the flood of last year; a liberal estimate should be made of the total cost of building these levees, and of protecting the adjacent banks of the river throughout the whole length of the levees with revetments; an estimate should be made of the largest annual appropriation of money that could be efficiently expended by the largest force that could be concentrated

upon the work; and finally the execution of the work should be placed entirely in the hands of the Army Engineers with a Col. Goethals in supreme and unhampered control.

Such an estimate of the total cost of a completely leveed and revetted Mississippi River has been made by the Army engineers under the Mississippi River Commission. The total expenditure would be about \$70,000,000 for the levee work and about \$90,000,000 for the revetment.

Is complete control of the Mississippi River and the absolute prevention of disastrous floods worth the expenditure of \$160,000,000? The Scientific American is decidedly of the opinion that the money would be well spent. In the first place, the completion of this work would afford protection to 29,000 square miles of land. The increased value of the land, due to protection, is shown by a statement of Col. Townsend, president of the Mississippi River Commission, who has recently testified before the Committee on Rivers and Harbors in the House of Representatives that 20 years ago, when he was first stationed in the St. Francis Basin, land in that vicinity could be bought for a dollar or two an acre, whereas to-day it is worth anywhere from \$20 to \$50 and even \$100 an acre. Furthermore, there is the humanitarian consideration that this work would prevent the great loss of life and destruction of property which occurs when the river breaks loose. And, finally, there is the consideration that the completion of this task will constitute a great national work of engineering comparable, in its magnitude and beneficent results, with the execution of the Panama Canal.

We will now proceed to discuss the criticisms of the present plan and the suggestions of alternative schemes of control which have been made in the many letters referred to above. It has been stated that the whole principle of levee building is wrong; and this for the reason that the matter brought down in suspension is deposited along the bed of the river, which is continually being raised, that this necessitates a raising of the levees, which must go on indefinitely. As a matter of fact, what takes place is this: When the floods come down, the deep pools are scoured out and the material is deposited on the shoals farther down the river, causing a temporary raising of the bottom at these points. As the river falls, the action is reversed, the bars are scoured out, and the sand is deposited in the next pool. Careful surveys for several decades show that not only has there been no raising of the river bed, but the cross section of the river has slightly increased.

As to the proposal to control the Mississippi by building vast reservoirs near the headwaters of the river and its tributaries, it may be said at once that the magnitude and cost of such reservoirs and the enormous areas of land that would have to be condemned, render

such a scheme impracticable. Its advocates have failed to realize the stupendous magnitude of a problem which involves the control of flood waters that sweep down the Mississippi River at the rate of 2,300,000,000 cubic feet per second. Testifying on the point, Col. Townsend said before the House Committee: "If you were to destroy the whole State of Minnesota—that is, stop every bit of water flowing over it—it would not have made a difference of three-tenths of a foot in the height of the last flood at Cairo." Again, if, as has been suggested, the St. Francis Basin were converted into a storage reservoir and the floods were thereby reduced 3 or 4 feet in height, it would be necessary to sacrifice no less than 7,000 square miles of country, or the area of a good-sized State.

Another favorite scheme contemplates the diversion of the Mississippi or of a large portion of its flood waters, by means of sub channels, or "canals," excavated on one side or the other of the river. This suggestion also fails to appreciate the magnitude of the problem. If such channels were to be cut, they would have to be leveed in exactly the same way as the river which they were intended to relieve. To produce any serious diminution in the height of a river that was passing down 2,300,000,000 cubic feet of water per second, it would be necessary to divert from 400,000 to 600,000 feet per second; which means that an artificial river would have to be excavated and leveed whose flow would be from two to three times as great as the whole flow of the Niagara River.

The proposition to straighten out the river by cutting through the bends is impracticable for the reason that while the more rapid flow would relieve the flood in the districts thus affected, this relief would be obtained at the expense of the districts lower down the river. The swifter current of the flood water, due to the shorter course, would necessitate a corresponding increase in the height of the levees in the lower sections of the valley.

As to the important question of financing the work, the simplest and most effective plan, of course, would be to do with regard to the Mississippi as we have done at Panama—make it a national problem and provide the whole cost from the National Treasury. Hitherto the Government has put up so much money; so much has been contributed by the local levee boards; and in one case, at least, the State has made appropriations. It is not surprising to learn that Col. Townsend designates such conditions as amounting to practically "an absence of system." Says he: "We have just simply been waiting, each one doing the best he could—the levee boards have been doing their work, and the district engineers have been doing whatever they could with their funds, and it has been a happy-go-lucky method of business."

We believe that the most satisfactory way of financing the project would be for Congress to treat the improvement of America's greatest river as a national undertaking, make the necessary appropriations, abolish the system of individual boards, and place the execution of the work under the one-man control of the Army. Next to this the best plan would be one of joint Federal and State appropriations, in proportions to be determined by the local advantages secured; with the physical design and execution of the work intrusted to the Corps of Engineers of the Army, working under the absolute control of an Army officer of proved executive ability.

In another year the Panama Canal will be completed. Why not move Col. Goethals with his admirable staff and perfectly working system from the Isthmus of Panama to the Mississippi Valley?

APPENDIX B.

ELEMENTS OF FLOOD CONTROL.

*Address Delivered by Col. C. McD. Townsend, Corps of Engineers,
United States Army, and President Mississippi River
Commission, Before Drainage Congress at
St. Louis, Mo.*

MR. PRESIDENT AND GENTLEMEN: The subject of land drainage is intimately associated with that of river improvement. The cultivation of the soil largely increases the amount of sediment entering our streams; the direction of the furrow markedly affects the amount of rain water that flows from its surface, and every ditch or subsurface drain promotes a more rapid flow into our rivers during floods and possibly affects their discharge during low water. On the other hand, no satisfactory system of land drainage can be accomplished in a country subject to periodic overflow by river floods. In the Mississippi Valley protection from floods is absolutely required before any regular system of drainage can be inaugurated. The overflow is so great and the amount of sediment carried by the river so large that the drains would be annually destroyed or filled. The floods not only insure the destruction of any crops that might be planted, but also usually occur at such times as to prevent the harvesting of a second crop the same year. A discussion of the means of preventing floods in the Mississippi Valley is therefore particularly appropriate at this meeting. In a paper read before a levee convention in Memphis last September I briefly discussed the various means of flood control which had been suggested to the Mississippi River Commission. Now I propose to confine my remarks to the three methods in which the public appears most interested, i. e., reforestation, reservoirs, and levees.

SOURCES OF FLOODS.

Before entering upon such a discussion it is desirable to have a clear conception of the sources from which floods arise.

As you will recall, the greater Mississippi Valley is bounded on the east by the Appalachian chain and on the west by the Rocky Mountains. These mountain ranges exert a great influence on its floods. The winds blowing from an easterly direction deposit most of the moisture they absorb from the Atlantic Ocean on the eastern slope of the Alleghenies, and therefore cause little rain in the Mis-

Mississippi Valley; the Rocky Mountains intercept the moisture from the Pacific Ocean. While showers occur from winds blowing over the Great Lakes, the original source of the floods of the Mississippi is to be sought in the Gulf of Mexico.

WHERE OUR FLOODS COME FROM.

During the winter and spring the land of the Mississippi Valley, no matter what its soil or the nature of its covering, is cooler than the waters of the Gulf, and a southerly wind, becoming saturated with moisture as it passes over the water, will precipitate that moisture on the land in copious rains, or in snow when the temperature is sufficiently low. A wind from the southwest sweeps up the Ohio Valley, one from the south carries moisture to the upper Mississippi, one from the southeast to the valleys of the Arkansas and the Missouri, but in all cases there is a tendency for the greatest rainfall to occur near the coast, and gradually to decrease as the wind currents travel inland. Thus the average annual rainfall at New Orleans is 60 inches, at Memphis 52 inches, at Cincinnati 42 inches, at Pittsburgh 36 inches, and at St. Louis 40 inches. At the headwaters of the upper Mississippi it is but 25 inches, and at the headwaters of the Missouri but 13 inches. Though floods do not arise from mean conditions, but from exceptional rainfall, when 6 to 10 inches fall in a week, these figures are good indices of flood volumes, as we find from observation by the Geological Survey at Williston, N. Dak., that the flood discharge of the upper reaches of the Missouri is about 1 second-foot per square mile of drainage area; measurements at St. Paul give an extreme flood discharge for the upper Mississippi of slightly over 2 second-feet per square mile. In the Ohio it is about 6 second-feet, and in the Ouachita, St. Francis, and Yazoo Rivers from 8 to 10.

From the above it will be seen that the rainfall is very unequally distributed over the Mississippi Valley, being least at the upper sources of the tributaries and rapidly increasing as you approach the main stream, though an exception is to be noted in the southern tributaries of the Ohio, whose sources are nearer the Gulf than are their outlets.

The maximum discharge of the upper Mississippi River is estimated at 450,000 second-feet; the Missouri, 900,000; the Ohio, 1,400,000; the Arkansas, 450,000; and the Red, 220,000. There is also a large discharge from the Yazoo, St. Francis, White, Tensas, and Ouachita Rivers. The maximum discharge of the Mississippi during the flood of 1912 was about 2,000,000 second-feet at Cairo and 2,300,000 at the mouth of Red River. It overflows its natural banks when the flow exceeds 1,000,000 second-feet.

While the influence of forests on stream flow has received little attention in this country until recently, the scientists of Europe have

discussed the subject pro and con during the past 40 years. It is generally accepted by both sides that the leaves falling from forest trees as they decay form a humus which has a large capacity to absorb water, and that when the forests are felled this humus is seriously injured by forest fires. It is also admitted that snow is more rapidly melted when it is exposed to the direct rays of the sun in an open field than when sheltered from such action in a forest. In fact, it has been found by the United States Forestry Service from experiments recently made in the White Mountains that the flow from cleared fields under such conditions is about twice that from forests. The forest advocates claim that this is sufficient proof that forests absorb water during flood periods which percolates through the ground and flows from springs later in the season, thus reducing flood heights and increasing the low water flow of rivers. Its opponents do not admit that the problem is thus easily solved. They claim that floods do not arise from the melting of snows by the direct action of the sun; that this process is so slow that the water which flows off would not raise a river to mid-stage; that floods occur when on a layer of snow there falls a copious supply of rain, and both the rain and melted snow enter the stream simultaneously; and that under such conditions the forest, instead of being beneficial, is injurious. On cleared land the wind tends to blow the snow from the ridges and piles it in immense masses in the ravines, while in the forests the snow is uniformly distributed. A few days of sunshine dries out the ridges in the open field and melts sufficient snow in the forest to saturate with water the underlying humus.

If a heavy rainfall then occurs the forest humus, being saturated, can absorb no more water, and the combined rain and snow of the forest flows into the streams, while in the cleared land, the ridges having dried out, absorb a large portion of the rainfall, and the snowdrifts expose a much smaller surface to the action of rain. Moreover, during periods of great drought the forest humus and long deep tree roots also absorb more water than grass and farm crops, and retard the run-off at a time when it is most needed for low water navigation. They therefore maintain that a forest is a fair-weather friend of some use in regulating the mid-streams of a river, but an utter failure when most needed; that is, during extreme floods or extreme low water. While I consider this discussion valuable my objections to reforestation are not based solely on a scholastic argument.

TIME TO REFOREST.

It requires from 20 to 50 years to produce a good forest growth, and over a century for the leaves of that forest to decay in sufficient

quantities to produce the humus which will be satisfactory as an absorbent of rainfall. We can not afford to delay the drainage of the Mississippi Valley even to produce the forest growth without taking into consideration the time required for the humus to form. We are more vitally interested in the height that the river will attain in the next few weeks than in what will occur in the year 2013.

It is also pertinent to this discussion to determine what would be the extent of the forest reservation which would be required to reduce the flood heights on the Mississippi River a given amount. To solve this problem it is necessary to make certain assumptions, and for purposes of argument we will take it for granted that reforestation will reduce the flood discharge of a stream one-half. The Mississippi flood of 1912 attained the greatest height of any then recorded at all gauge stations except at Vicksburg. That of January and February, 1913, while 5 feet lower at Cairo, was the next highest flood at Memphis and for a considerable distance along the river. We will endeavor by reforestation to reduce the flood of 1912 to the heights attained in the winter of 1913. For this purpose it will be necessary to reduce the maximum discharge of the river 500,000 second-feet. It will also be necessary to distribute this reduction among the tributaries, reducing the maximum discharge of the Missouri River from 900,000 to 700,000 second-feet, that of the upper Mississippi from 450,000 to 350,000, and that of the Ohio River from 1,400,000 to 1,200,000.

As stated in the introductory remarks, the flood discharge of the Missouri River at its headwaters is about 1 cubic foot per second per square mile of drainage area, and if the reduction in discharge of one-half is to be secured by reforestation 2 square miles of forests would be necessary for every second-foot of reduction of flood discharge, or 400,000 square miles of forests to reduce the discharge of the Missouri River 200,000 second feet. At the headwaters of the upper Mississippi the ratio of flood discharge to drainage area is about 2 second-feet per square mile. A reduction of this discharge by one-half would require a forest reservation of 100,000 square miles to reduce the floods of the upper Mississippi 100,000 second-feet. On the Ohio River the ratio is 6 to 1, and it would therefore require forests at the headwaters of the Ohio having an area of 66,000 square miles to reduce its flow 200,000 second-feet. In other words, to reduce the height of a flood at Memphis by reforestation at the headwaters of the river from that of 1912 to the next highest on record would require a forest reservation of about 566,000 square miles, an area exceeding that of the portions of Montana and Wyoming drained by the Missouri River and the States of North and South Dakota, the portion of Minnesota drained by the upper Mississippi River, and the States of Iowa, Wisconsin, Illinois, and Indiana. But even such a forest reservation would afford only

partial protection, and large expenditures for levees would still be required. Under the above assumptions, to prevent any overflow by reforestation would necessitate a practical abandonment of the valley for agricultural purposes and the development of an extensive irrigation system to produce tree growth in arid regions of the West.

It is therefore apparent that even under the most extravagant claims of forestry advocates reforestation as a means of reducing flood heights on the Mississippi River requires the conversion of too much farming land into a wilderness to be practicable. The waste land that can profitably be converted into forest reservations is too limited in area to produce an appreciable effect on the floods.

RESERVOIRS.

To have retained the Mississippi flood of 1912 within its banks would have required a reservoir in the vicinity of Cairo, Ill., having an area of 7,000 square miles, slightly less than that of the State of New Jersey, and a depth of about 15 feet, assuming that it would be empty when the river attained a bank-full stage. If the site of such a reservoir was a plane surface, the quantity of material to be excavated in its construction would be over 100,000,000,000 cubic yards, and its estimated cost from fifty to one hundred million dollars. Such a volume of earth would build a levee line 7,000 miles long and over 150 feet high.

Cairo is the logical location for a reservoir to regulate the discharge of the lower Mississippi. It will not only control the floods from the Ohio, but also the discharge from the Missouri and upper Mississippi. But if the reservoirs be transferred from the mouths of the tributaries to the headwaters, their capacity must be largely increased. No two floods have the same origin, unless they are referred back to the Gulf of Mexico. The wind bloweth where it listeth. If the prevailing winds in the early spring are from the southwest, the southern tributaries of the Ohio furnish the crest of the year's flood; if more nearly from the south, reservoirs will be required on the streams of Ohio, Indiana, and Illinois; a slight varying of the wind will produce a flood in the upper Mississippi, while if it blows from the southeast the principal sources of trouble will be the Red, Arkansas, and Missouri Rivers. To control the flow of every stream in the Mississippi Valley by reservoirs is a pretty large job, even for the United States Government, but that is what the control of the Mississippi during floods by reservoirs signifies.

The advocates of the control of the floods of the Mississippi by reservoirs do not, however, have in mind any such radical control as is above indicated. They limit the control to the headwaters of the various tributaries, and while every stream that flows in the valley may be considered a headwater of some tributary, I judge from the discussions of the reservoirs and their proposed employment for

power purposes, which requires a considerable height of dam, that by headwaters is meant the sources of the rivers in mountainous countries as distinguished from the more level plains, and, more specifically, the sources of the Missouri above the mouth of the Yellowstone, those of the upper Mississippi in the State of Minnesota, and those of the Ohio in the Appalachian range.

The flood which has been devastating the country affords data for determining the effect of such a system of reservoirs, and its lessons are the more valuable because no effort is necessary to refreshen the memory. When, on April 2, the gauge at Cairo attained a height of 54 feet, there was flowing down the Mississippi River at least 2,000,000 cubic feet of water per second. It requires about 11 days for a flood wave to be transmitted the 966 miles between Pittsburgh, Pa., and Cairo. On March 22 the Pittsburgh gauge read 5.3 feet, which is produced by a flow in the Ohio River at that locality of about 15,000 second-feet. In 10 days a flood travels the 858 miles between St. Paul, Minn., and Cairo. On March 2 the reading of the St. Paul gauge was 0.5 foot, corresponding to a discharge of the Mississippi of about 2,500 second-feet. In 8 days the effect of a flood at St. Joseph, Mo., is felt at Cairo. On March 25 the gauge at St. Joseph read minus 0.1 foot, representing a discharge of the Missouri River of about 17,000 second-feet. If a system of reservoirs had been constructed which would have prevented all flow from the Alleghany, the Monongahela, the Mississippi above St. Paul, and the Missouri above St. Joseph, it would have reduced the 2,000,000 second-feet discharged by the Mississippi River at Cairo on April 2 less than 35,000 second-feet.

The water which passed Cairo on the 2d of April came principally from the White and Wabash and the lower tributaries of the Ohio, and after the water of these rivers started to subside the flood from Cincinnati, though increasing from 57 to 69 feet on the gauge, could increase flood heights at Cairo less than 1 foot. The flood of 30 feet at Pittsburgh on March 28 produced its effect on the Cairo gauge on April 8. It has prolonged the flood without increasing its height.

The proposed system of reservoirs would have cost hundreds of millions of dollars and its effect on this year's flood height of the lower Mississippi could not possibly have exceeded 6 inches.

Neither the rain nor snow which falls upon the mountainous portions of the Mississippi watershed has much effect upon the floods of the lower river. The principal source of the floods is the great alluvial plain between the mountains. As I have pointed out, excepting the southern tributaries of the Ohio, the rainfall is relatively slight at the upper sources of the tributaries and their maximum flood discharge does not usually coincide with that of the mid-valley.

Great floods do not arise from average conditions, but from exceptional variations such as are caused by a series of heavy rains rapidly succeeding one another. Each rainstorm starts down a stream a flood, the volume of which can be absorbed by a reservoir with comparatively little trouble, but if a second storm sweeps over the valley the reservoir, to be effective, must be emptied or its capacity doubled. To hold all the excess rainfall till low water would require reservoirs of enormous capacity. Economic considerations usually require that the reservoirs should be emptied as soon as the crest passes, in order to utilize the same space for a second rainfall; so that while reducing the crest of a flood at a given locality they necessarily prolong the period during which the river remains at a high stage.

The water which is abstracted from the Gulf of Mexico is usually precipitated in the Mississippi Valley within a period of 2 days. The return flow extends over a period of 2 or 3 months. The sum of the maximum discharges of the various tributaries of the Mississippi River is nearly 4,000,000 second-feet, while the greatest measured discharge of the river itself is about 2,300,000. This apparent discrepancy arises from the fact that the floods of the tributaries do not reach the Gulf at the same time. The crest of the Ohio River flood usually passes down the river in March or April, that of the Missouri in May or June. Moreover, the same law applies to the tributaries of a tributary. The waters of the southern branches of the Ohio tend to discharge into that river before those in Ohio, Indiana, and Illinois.

By the construction of reservoirs this beneficent law of nature is deranged. Instead of the crest of the flood of one stream passing down the river before that of another reaches it, two prolonged high stages will obtain which will tend to synchronize and the resultant combination may be higher than either flood would have been by itself.

A system of flood control designed to be satisfactory for one city may be most disastrous to another locality farther downstream. If a system of reservoirs had been in operation in the Allegheny and Monongahela Rivers during last January it would have protected Pittsburgh from overflow and diminished the flood at Cincinnati when it was 50 feet on the gauge, but only to increase it when it attained a height of 60 feet. And this effect would have been propagated to the Gulf.

Pittsburgh, moreover, would never consent to such a manipulation of reservoirs on the upper tributaries of the Ohio as would insure the reduction of floods at Cincinnati or on the lower Mississippi. Source stream control on the Mississippi River and its tributaries would therefore soon reduce itself to the question of whose ox is to be gored.

LEVEES.

While the use of forests or reservoirs as a means of flood control is still in an experimental stage all over the world, the employment of levees for this purpose has been tested for centuries. The Po, Rhine, Danube, Rhone, and other rivers of Europe have been successfully leveed. The laws governing the flow of water in a confined stream have been carefully studied and the construction of levees is just as susceptible of mathematical analysis as other engineering problems. There is an element of uncertainty in all the forces of nature. No one can say positively, for instance, that St. Louis may not at some future time experience an earthquake, or a cyclone of greater intensity than that which swept over the city in 1896. There is also a possibility that there will be some combination of meteorological conditions which will create a flood of greater volume than has heretofore occurred in any drainage area. But the height to which levees should be constructed is as susceptible of determination as the strains to be permitted in an office building due to wind pressure or the moving load allowable on a bridge. The city engineer solves a similar problem whenever he constructs a sewer to carry off the storm water from the city streets.

Nor is there any evidence either that floods have been increasing in recent years due to the cutting off of forests or that the beds of our main rivers are rising as they are leveed. The effect of forests on rainfall in Europe have been carefully investigated by Profs. Schlichting and Hagen. The records at London, Paris, St. Petersburg and other localities where the rain has been recorded for long periods fail to show any tendency to an increased fall in recent years.

The meteorological records of the United States have not been maintained a sufficient length of time to be of much value in solving the problem. Such data as we possess indicate that the flood discharge has not increased in recent years. The greatest flood of the Mississippi at St. Louis occurred in 1844, the next largest in 1785. On the Great Lakes the high water of 1838 is the greatest on record. In the Ohio the flood of 1884 exceeded that of 1913 at Cincinnati, and that of 1832, while 5 feet lower at Cincinnati, was 5 feet higher at Pittsburgh than this year's flood. The gauge records at the bridges over the upper Mississippi, which cover a period of 30 years, would indicate that the flow from Minnesota and Wisconsin, where the forests have been most extensively destroyed during the period, has been slightly improved, though the river shows signs of deterioration where it receives the flow from the prairie lands of Iowa and Illinois. They appear to confirm the conclusions of the German forestry authorities that the influence of forests on drainage is concealed by other causes more powerful in their effects.

The flood of 1913 was not due so much to excessive precipita-

tion as to the fact that the surface of the ground was frozen over the States of Illinois, Indiana, and Ohio so that there was not the soil absorption of rain water that usually occurs.

CAUSE OF 1913 FLOOD.

There is not the remotest connection between deforestation and the disasters which have just occurred at numerous cities in Ohio and Indiana. The flood of 1832 was similar to that of 1913, but it was discharged by streams of the dimensions the Creator intended they should have. Since then cities have sprung up and land has become so valuable that riparian owners have encroached upon the waterways. Where the floods formerly flowed untrammelled, factories and dwellings have been constructed and numerous bridges have further restrained the stream's discharge. When His laws are violated, though slow to anger, the Creator occasionally asserts His might and the works of man crumble before Him. If it would accomplish any useful purpose, I could name other cities where conditions are as dangerous as at Dayton or Columbus, but the lessons of the flood will be forgotten with the burial of its dead.

The question of the rise of the river bed by levee construction has been exhaustively investigated. On the Rhine the maximum effects were observed at Dusseldorf, where the same discharge at low water appears to attain a height 8 inches greater to-day than it did 100 years ago, while the same discharge at high water has lowered about 1 foot in a century. On the Po the maximum observed change in low-water conditions was 0.02 of a foot per year, but it is by no means proven that even these small changes have resulted from levee construction. They may have arisen from the improvements in the river bed which were made simultaneously with levee construction. The observations of the Mississippi River Commission agree with the Dusseldorf observations in that the Mississippi River appears to be slightly enlarging its section, at least at mid-stages.

The present contents of the adopted levee line of the Mississippi River is about 243,000,000 cubic yards. It has been computed that with an addition of 200,000,000 cubic yards and at an estimated cost of \$57,000,000 this line would be safe against any flood which has occurred in the Mississippi River. This sum, though large, is less than \$4 per acre of land protected from overflow, and appears insignificant when compared with the amounts which are being expended per acre for irrigation purposes in the arid west. The increase in the value of land on the damage caused by one overflow like that of 1912 would pay for the completion of the levee system.

When a levee line contains but one-half the material that safety requires, crevasses afford no argument against levee construction. During the flood of 1912 hundreds of miles of levees were topped

with earth in sacks to a height of from 2 to 4 feet, to prevent the water flowing over them, and water was seeping through their narrow bases in copious streams, which was unheeded until mud began to flow. The levee which failed at Beulah, Miss., recently was held till the pile of sacks exceeded 20 feet in height.

The holding of 1,525 miles of such levees through the flood of 1912, even though 13 miles failed, is a powerful argument in favor of a properly constructed levee line. There was no failure where levees were built to a suitable grade and adequate dimensions, as in the upper Yazoo district.

WHAT HE FAVORS.

CONCLUSION.

While of the opinion that levees afford the only practicable method of controlling the floods of the Mississippi River, in conclusion I desire to state that I am strongly in favor of both reforestation and reservoir construction, but limited to the purposes for which they are adapted, just as I am in favor of reenforced concrete for small bridges, though not considering it applicable to one spanning the lower Mississippi River. The price of lumber to-day is a sufficient argument for planting trees, without attempting to associate forestry with the climate or with the flood conditions on our rivers. If the Federal Government or the States do not conserve the forests, the time will soon come when the farmer will raise his crop of timber just as he now plants a field of wheat, and for the same reason, because it will pay him to use his waste land for the purpose.

WHEN RESERVOIRS ARE NECESSARY.

Reservoirs are necessary for municipal water supplies, for purposes of irrigation, for the development of power, and for feeders to canals. They can be successfully employed on small streams to diminish floods or increase the low-water flow. The trouble arises when an attempt is made to utilize them for too many purposes at the same time. There must be a paramount issue to which the others will be subsidiary.

If the main purpose is to supply a city with water only the excess can be used for power development. If the dams are constructed to produce power, the reduction of floods and the improvement of river navigation must be subordinate thereto. Water required for irrigation can only be used to develop power when the dam of the storage reservoir is given a greater height than is necessary for its flow over the land to be reclaimed.

During the next decade there will be an enormous development of reservoirs, both for irrigation and for power purposes, which I

hope will be utilized to correct man's folly and prevent many disasters similar to those which have recently occurred in Indiana and Ohio. While the control of the lower Mississippi by reservoirs is impracticable, there are numerous smaller streams where they can be used with excellent results.

It is questionable, however, whether such reservoirs should be built with the control of our rivers the first object of consideration. It will, to be sure, saddle the cost on the United States Treasury, but to close down a power plant and stop the growth of crops every time the navigation of a minor stream is interfered with, I do not consider would be a wise proceeding.

I am also skeptical of Government ownership. It may have worked satisfactorily in irrigation projects, but my own experience with Government ownership of water power makes me suspicious. I have found that when the Government buys water power, the powered companies consider it worth \$25 per horsepower per year, but when conditions are reversed, and an attempt is made to lease it, the price drops to 10 cents.

Wherever it will pay to build a dam for power purposes, capital stands ready to construct it, if it can obtain the franchise. By regulating the franchise the reservoir can also be used to restrain local floods.

The systematic conservation and regulation by the Government of a river from its source to its mouth sounds most attractive, suggesting a scientific solution of every problem of river hydraulics, but instead I greatly fear that it is the voice of a siren luring the people to an open pork barrel for every stream in the United States.

APPENDIX C.

MISSISSIPPI RIVER.

COMMITTEE ON COMMERCE,
UNITED STATES SENATE,

March 2, 1910.

Senator William P. Frye presiding.

The CHAIRMAN. Judge Taylor is here, I believe. Judge, will you please take the stand?

STATEMENT OF JUDGE ROBERT S. TAYLOR.

Mr. TAYLOR. Mr. Chairman and Senators.

The CHAIRMAN. Judge Taylor, what is your official position now?

Mr. TAYLOR. I am a member of the Mississippi River Commission.

The CHAIRMAN. How long have you been in that position?

Mr. TAYLOR. Since March, 1881.

If I am allowed to pursue my own wishes, I will address myself to the provision of the bill which makes an appropriation of \$2,000,000 for the Mississippi River below Cairo. I desire to impress upon the committee the emergency which exists for the use of that money upon the lower Mississippi. The work of the Government upon the river below Cairo has been conducted in the prosecution of two great projects. One was the improvement of the channel for commerce and the other was the reclamation of the alluvial valley from floods. One of these projects, the second one, has been substantially accomplished, and I do not know any words by which I can adequately express the greatness of that work and its value. The alluvial valley of the Mississippi below Cairo comprises 29,790 square miles of alluvial deposit, extending to a great depth, and its products are of the choicest kind. The upper one-third of the valley, extending about to Memphis, produces corn in the greatest possible perfection and grasses and other crops of that character. The central one-third, extending from Memphis to the Red River, produces cotton, and the lower one-third, from the Red River to the Gulf, produces sugar and rice.

The protection of the valley against flood by levees began about two hundred years ago at the site of New Orleans. The levees built then were very small; they did not need to be high. In time

of great floods the water spread over the whole valley and flowed down to the sea in the form of a great, slowly moving lake of comparatively shallow depth. The settlers at New Orleans found themselves upon a comparatively high piece of bank land which did not need a levee higher than this table here [indicating] to protect them from the overflow. The levees gradually extended upstream; the progress was very slow indeed; and as they went upstream they gradually included in the channel water which had formerly gone over the country at large. The effect was to increase the flood height little by little until by the time they had reached Red River the flood height had been very materially increased. The Government began its co-operation in the work of levee building in 1882. Since that time the work has been prosecuted by the Government and the States in co-operation. The Government has expended on the levees since that time about \$23,000,000, and the States and riparian communities have expended 50 per cent more than that at least; but the exact amount is not known.

Senator BURTON. You mean \$23,000,000 expended by the Government and 50 per cent more expended by the localities—that would make \$34,500,000.

Judge TAYLOR. Yes, sir; they have expended as much as \$34,000,000, or more than that.

I think it is entirely safe to say that for every \$2 which has been expended by the United States Government since 1882 the riparian communities have expended \$3. The administration of this fund in the hands of the Mississippi River Commission has been conducted with a view to securing the best possible degree of co-operation from the riparian communities. It was from the beginning the rule of the commission to help most those who helped themselves most, and the people all the time have done all that they possibly could to contribute to the building of the levees. The levee lines now extend a distance of nearly 1,500 miles—from the Gulf to a point some little distance above Cairo. They have confined the flood within the channel with substantial success for nearly ten years. The levees that existed before 1882 were light and low and weak, as compared with those that exist now. They have been increased very much in height and strength since 1882.

The result has been a wonderful development of the country. A generation of people have grown up since the work began. They have acquired confidence in protection from the floods, and the whole valley is alive with progress and prosperity. The value of land has increased prodigiously. I know I am not stating anything extravagant when I say that the value of land in the valley since the beginning of the levee work under the co-operation of the Government has increased threefold from Cairo to the Gulf on an average. The railroads are threading the country as thickly as in New

England. Every form of business is in a state of the highest activity; factories, mills, banks, and every agency of active business have multiplied to a surprising degree. All that is necessary to reclaim the whole valley completely and bring it all into a state of cultivation is surface drainage, and that work is now in active progress. There have been many drainage associations organized under the law and drainage canals for carrying away the surface water are being built in all parts of the valley at great expense and with great energy. I repeat, as I said before, that I do not know where to look in the whole world and in all history for so splendid an example of reclamation as has been accomplished by the levees of the Mississippi River. The work that has been done would have been impossible without the co-operation of the Government. I suppose that if the Government had kept its hands off, levees would have been built some time, adequate to restrain the floods, but I do not think it would have been—it could not have been—accomplished until near the end, or perhaps after the end, of this century. No system of levee building by means of forced assessments for immediate construction would have been possible without sacrifice of a large part of the property in the valley. The levee districts have not only taxed themselves in every practicable form, by taxes on the uncultivated land, by another tax on the cultivated land, by taxes on the cotton and other crops, but they have borrowed money and have millions outstanding now of levee bonds upon which the levee districts have to carry heavy burdens of interest. What has been done, Mr. Chairman, in my opinion, could not have been brought about by any possibility in any other way except that in which it has been done. It appears to me that a work of reclamation which has been so well accomplished and which is of such incalculable value is no more to be abandoned—there should be no more thought of abandoning it than of abandoning New York Harbor or the Panama Canal.

But we have now reached a crisis in the work. Up to this time the commission has been compelled to devote the money appropriated to be expended under its direction to immediate and dire emergencies. After work had got along to a point at which a navigable channel was secured 9 feet in depth, and it had become certain that it could be permanently maintained, then the commission devoted its energies very largely to the completion of the levee system to a point at which it would protect the valley from overflow. It reached that point with substantial success nearly ten years ago. The problem now is to preserve them. The danger which threatens them is undermining by the caving banks. In the face of that danger the ordinary recourse has been to move the levee back and make a loop, which will carry it away from immediate danger. In the old days, when the levees were comparatively

small, that was an easy thing to do, but the completion of the system so as to hold the floods has necessitated the building of levees to much greater height, so that it has become a much more serious matter to make a loop than it was twenty-five years ago. Moreover, this sort of situation is frequently occurring: The alluvial valley below Cairo has many crescent-shaped lakes which lie near the river which are the remains of old river bends which have been cut off in the river's shiftings and left inland, and the ends of which have silted up so as to form lakes of crescent shape.

Now, it is no uncommon thing for an important line of levee to stand on a narrow neck of land between the river and one of those lakes. In such a situation it is impossible to make a loop without going around the lake, which may take a long distance, and over marshy ground where the building of a levee is pretty nearly impracticable. In such a case as that the most economical way, and almost the only way, may be to revet the bank at that place and stop the caving. The commission has always been very shy about doing that because of the expense of revetment, and they have never made revetment for that purpose except under the pressure of the most dire necessities. The first one built was at Bolivar, in Mississippi, in 1888. There a very large and costly levee 30 feet high, I should say, at its highest point, stood upon a narrow neck of ground only a few hundred feet wide between a rapidly caving bank and Lake Bolivar. To let that levee go and carry a new one around Lake Bolivar and across its outlet bayou would have involved an enormous expense, besides throwing out a very large area of cultivated land; and so the commission determined to build a revetment at that point to protect that levee. That revetment is there to-day, and has been a complete success. It has had some extensions and repairs, but in all the years that have elapsed since 1888 to the present time the levee has not moved or changed, and the revetment has not moved or changed.

Senator BURTON. That was not the first revetment, or was it?

Mr. TAYLOR. No; not the first revetment, but it was the first revetment built for the express purpose of protecting a levee at a critical strategic point. The next one built was at Lake Providence, farther down, in 1894. The town of Lake Providence is situated upon the bank of a lake by that name close to the Mississippi River, and caving had approached to within a very short distance of the levee. To let the levee go was to let the town go and require the building of another levee around Lake Providence, and to do that it would be necessary to cross the Tensas Bayou, a project that would have been expensive and difficult in the extreme. That revetment was put in in 1894 and has been entirely successful. It stopped the caving, and the town of Lake Providence has been saved, and all the country round about there has been saved from

inundations, which it would have been almost impossible to prevent otherwise. Such emergencies as these when they come are dreadful. The alternative of letting a levee go under those circumstances is one to stagger a man. This situation has been coming along gradually for ten years, and it became acute, I should say, about four years ago, when the Rivers and Harbors Committee of the House was framing the last rivers and harbors bill. The committee had made up its mind to make an appropriation of \$2,000,000 for the current year and \$2,000,000 more per annum for the three years following. I went before the committee and presented facts substantially like those I have just stated. I asked that we might have \$3,000,000 per annum instead of \$2,000,000. I got down on my knees to the chairman, Senator Burton, as I think you will remember, Senator.

Senator BURTON. I do not quite remember that. You mean metaphorically?

Mr. TAYLOR. Metaphorically; yes, sir; and he finally consented to allow us an extra million for that year, and I think he did it more because I was on my knees than for any other reason. I begged it of him. That million dollars was worth several millions to the river. With that million dollars we were able to do some work of tremendous importance. Since that time we have been getting along on two millions a year—as Eliza crossed the river, in Uncle Tom's Cabin,—as you will remember, she crossed the Ohio River at Cincinnati about this time of year, with her baby in her arms, by jumping from one cake of ice to another. For the last three years we have been just jumping from one cake of ice to another. We have been in the face all the time of tremendous possible disasters.

A crevasse is always a disaster, but a crevasse now, when the levees have got so high that it means an outpour from a head of 12 or 15 feet across a valley 20 miles wide, filled with people, plantations, houses, towns, and all that pertains to going society, becomes a dreadful calamity. We have felt as if we must not let that occur if we could possibly help it. To illustrate the straits we are in, I may say that the last time we went down the river we had just \$10,000 left in the locker from the previous appropriation. There was a place in the levee in the upper part of the valley where for some 5 or 6 miles the embankment was too low to stand a sever flood; and there was a revetment way down the river just above Natchez that is also greatly important. The question came up as we went down whether we would use that last \$10,000 to bring that piece of levee up to grade or put it on the revetment at Giles Bend, and we did not decide the question until we got down to Giles Bend and looked at it. We had the question before us all the way down the river, what we should do with that last \$10,000. When we got to Giles Bend we made up our minds that we would better put it on

the levee. We proceeded on the theory of the Irish inspector of railroad wheels, who hit a wheel a lick just as a passenger stuck his head out of the window and said, "It seems to me that wheel is cracked." The inspector said, "It is, sorr, but I think it will hold until the next station." We made up our minds that the revetment at Giles Point would hold until next year, while it was certain that we would have a crevasse in the Reelfoot levee with a very high flood. The \$10,000 was enough to make that safe, as we thought.

I have spoken about the disaster of a crevasse. It is always bad enough, but at this time, when the people have just learned what it is to feel safe and business and prosperity are booming, a few bad crevasses would be such a shock to confidence that the consequence in that way would be ten times as great a disaster as the destruction of the property by the overflow. Now, we are at this time confronted by conditions in a number of places where that disaster threatens and may occur at any time; and where there is no way of saving the levees except by revetting the banks in front of them; and for that purpose we ought to have \$4,000,000 this year, and the next year, and for several years.

Revetments are expensive work. A revetment requires a floating plant of something like 25 pieces, and costs something like \$150,000. As a rule, a plant can not do more than 4,000 feet in a season. Revetment can only be put in when the water is at a suitable stage, and experience has shown that we can sometimes, in a very favorable season, put in 5,000 feet with one plant; we can not count on more than 4,000 feet on an average. We have at the present time six revetment plants on the river, so that we are not in a situation to put in more than about 24,000 feet a year. If we could receive this year an appropriation of \$4,000,000, we could provide five or six new revetment plants. We do not want more than \$4,000,000 this year. There is a limit to the rapidity with which revetments can be profitably put in. The limit is found partly in the quantity of plant required, and partly in the practicability of getting labor, but more than that, in the supply of brush from which they are made. It takes about $3\frac{1}{2}$ cords of brush per running foot of revetment. We have heretofore in late years counted the cost of revetment at \$30 a foot, but it is growing on us a little, and I expect that for the next five or ten years they will cost as much as \$33 to \$35 a running foot.

With \$4,000,000 we could take care of the critical points in the river as rapidly as we could do it profitably under any circumstance. The places where revetments are immediately and imperatively necessary extend all the way from a few miles below Cairo to Natchez. A number of them are necessary to prevent cut-offs. I do not know to what extent the members of this committee are familiar with cut-offs and what they are, or why they ought to be

prevented. A man's first thought, in looking at a map of the Mississippi River, naturally, is that its numerous bends are defects and it would be better without them. In fact, President Hayes, who appointed the first Mississippi River Commission, said to General Gilmore, the first president, when he came in to express his thanks for the honor conferred, that he supposed the first thing the commission would do would be to take some of the kinks out of the river. But this is the truth about it: There is a certain relation between the velocity of the current and the resisting power of the bank in which stability of the channel is possible. If the bank is softer it will erode faster; if the current is more rapid it will erode faster, and vice versa. The river, by the laws of nature, is endeavoring all the time to find that relation between velocity of current and resisting power in the bank by which it may have a stable flow. As a caving bend extends back into the country it increases the length of the river and so diminishes its slope; but in that process of lengthening its bend it tends to turn upon itself and so cut off its own neck, and that shortens its length again. The shortening will be equal to the difference between the distance across the neck and the distance around the bend, which may be as 15 or 20 miles to a thousand feet. The important fact is that the cut-off introduces into the river at that point a fall, it may be of 6 or 8 feet, which produces such a violent increase of the velocity for miles above and below the cut-off that the river proceeds at once to attack its banks with renewed violence and lengthen its bends again. So, by extending its bends and increasing its length and then cutting off the necks and decreasing its length, the river is engaged in the constant effort to find some equilibrium between its velocity and the resisting power of its banks.

A study has been made of all known maps extending back as far as data can be obtained and comparison made of the changes, and it is known that the deepening of the bends in the last century has been enough to increase the river's length by many miles, and also that the cut-offs have been enough to reduce its length a great deal. I believe it was Mark Twain who said if the caving went on uninterruptedly for a century or so New Orleans would be 5,000 miles from St. Louis, and on the other hand if the cut-off process went on for a couple of hundred years New Orleans would be a suburb of St. Louis. As it is, a study of the subject has shown that the river has not perceptibly changed its length within a century. Its caving bends and cut-offs have compensated each other upon the whole during all that time. I wish I had the map here which you once had in the room occupied by your committee. It was a large wall map prepared by the Mississippi River Commission which showed the river and adjacent country from Cairo to the Gulf, including lands liable to overflow, levees, lakes, and bayous, all in de-

tail. It would be invaluable for your use just now. I suggest that you make a requisition upon Colonel Bixby right now to send you one from St. Louis. If I had that map it would delight me to show you one little stretch of river, known as the "Greenville Bends," where there are four great bends, one immediately above the other, around which for a hundred years the river has flowed without material change and maintained for itself a perfect channel.

But the demon of unrest has at last invaded those bends, and as long ago as 1890 the neck of the upper one began to cut away rapidly, and there was serious danger of a cut-off. Now, a cut-off in one of those bends—there being four of them, one right above the other—would introduce such a violent disturbance in the river that the bends would all go one after the other very quickly, and with all those bends cut out there would be chaos in that part of the river for half a century or more to come. So the commission began to build a revetment at the upper one—Ashbrook Neck, it is called—as long ago as 1890 and has maintained it ever since, and so has prevented a cut-off there. But quite lately the river has suddenly attacked the lower one of those necks—Leland Neck, it is called—with such fury that there is only about 700 feet remaining now which the river will have to go through in order to make a cut-off. A revetment has been begun there and should be prosecuted with all possible energy. To prevent a cut-off at that place is the most emergent piece of work on the whole Mississippi River.

Senator BURTON. How long is the revetment that is required there?

Mr. TAYLOR. We can not tell just how long it will have to be. It can not be less than a mile, and maybe 2 miles, or possibly more. It is necessary to cover all the bank that is caving at the time; generally something like a mile to start with. Then, if the caving shows a disposition to extend, the revetment is extended accordingly. I should think that it will be necessary to put in 2 or 3 miles of revetment at Leland Neck within the next two years.

Senator BOURNE. What would be the destruction of property if that cut-off took place?

Mr. TAYLOR. That could not be estimated at all.

Senator BOURNE. The destruction would be enormous?

Mr. TAYLOR. Enormous beyond any figures. That cut-off would precipitate another at once. These slender necks, one above the other, would go like a row of bricks—knock one down and you knock them all down.

Senator BURTON. What is the fall from the upper side to the lower side?

Mr. TAYLOR. In high water?

Senator BURTON. Yes.

Mr. TAYLOR. It is the fall around the bend.

Senator BURTON. I know. But how much is that?

Mr. TAYLOR. I should think it is not less than 7 or 8 feet.

Senator BURTON. Cutting across one neck in itself would not do any harm especially?

Mr. TAYLOR. No, sir.

Senator BURTON. But the different course the channel would take—

Mr. TAYLOR. The effect would be to induce a great increase of velocity in that part of the river which would extend for 50 miles and more up and down the stream. The cutting off of those four necks would induce a fall of 25 or 30 feet in the river. No one can tell anything about what the consequences would be of such a prodigious change.

Senator BOURNE. It would flood an enormous extent of territory?

Mr. TAYLOR. Yes, sir; a great extent of territory, and, what is worse, it would tear the banks and levees all to pieces. It would, for one thing, I think, destroy the city of Greenville in short order.

There was a cut-off in 1884 at Waterproof, which is about 20 miles above the city of Natchez. That is the only cut-off that has taken place in the Mississippi River within thirty years. I saw that almost at the moment it occurred. The river was high; we went down in our steamboat past the upper side of the bend and around the point. There was no indication of any trouble as we went along the upper side of the bend, but when we got around to the lower side there was a roar like Niagara, and the water was coming across the neck in great leaps, and by the next morning the steamboats were going up and down that channel. That cut-off introduced such an increased activity in the river that it immediately threatened another cut-off at Giles Bend, a little above Natchez. The caving on the upper side of Giles Bend was so accelerated by the Waterproof cut-off that within three years we had to begin a revetment there, and we have been at work at it ever since. We have got above five miles of revetment in that bend now. It has been a very difficult thing to keep that neck from being cut off.

I have spoken so far of revetments as means of preventing cut-offs and protecting levees, but if we are to look forward to the development and maintenance of a deep channel down the Mississippi River, whether it be 14 feet or less or more, then revetment assumes importance for another and entirely different purpose. The only impediment to navigation in the Mississippi River is the bars. These bars come almost entirely from the caving banks. There is some sediment coming into the Mississippi River at Cairo from the Missouri, but it is a comparatively small portion. Altogether the greater part of the sand which builds up the bars comes from the banks in the vicinity. The sand and loam scoured out of a

bend are carried—I should say partly carried and partly pushed and rolled—along the bottom to the foot of the bend, where it crosses the channel into the next bend below. At the point where it crosses the channel the current loses its velocity to a large degree, and with the loss of velocity has less power to transport sediment. Hence it deposits a large part of its load on the crossing below the bend from which it was taken, and that happens at every crossing. The greater part of the material that forms the bars comes from caving bends not far above. If the channel of the Mississippi could be emptied out, dry and clean, so that you could travel up and down it, you would find yourself passing through a series of small hills and valleys. You would go through a crescent-shaped depression or valley with a bank at your side 80 or 100 feet high. Then you would ascend a sand hill not quite so high, and then you would descend into another valley and then over another sand hill, and so on. Now, when the bed is filled with water these sand hills come up nearly to the top, and they constitute the only obstruction there is to navigation. In order to make the river navigable, we must cut off the tops of those bars. There are about 43 of them below Cairo that obstruct navigation now, or about that. What we do now is to trim off the tops of those sand bars with dredges. Their average length is about 800 feet, in some cases several hundred feet more than that.

Senator BURTON. Do you mean downstream?

Mr. TAYLOR. Yes, sir; downstream. They are, as a rule, about 800 feet long. I have sometimes been asked the question very frequently, in fact—whether the improvement of the lower Mississippi to a 14-foot depth is practicable. I answer without hesitation that it is. But, for a reason which will be apparent when you think about it in a minute, the difficulty of making a channel in this way increases rapidly as you go deeper. In order to make a 9-foot channel we have to cut off, say, 4 feet from the top of the bar, which is a common experience and an easy thing to do. For a 14-foot channel we would have to cut off 9 feet from the top of the same bar. We would have to cut not only deeper, but for a greater distance, to include the slope of the bar above and below. The cut would have to be made longer and deeper and wider, too. When it comes to that we may introduce changes in the régime of the river, which we can not exactly foresee. You see, at low water these bars are dams between pools; there is a pool in the bend above the bar, and there is a pool below, and when you cut through the dam the tendency of the increased flow is to lower the pool above a little bit. As little as 4 feet does not produce any visible change in the elevation of the pools above or below, but if we undertake to make a channel 14 feet deep and make a cut across the top of the bar 9 feet deep and 800 feet wide we will let the water out of the upper pool into the lower

pool in very large quantities, and if we repeat that process at every bar the tendency will be to lower the whole surface of the river at low water, and that will bring up more bars that are now too far down to give trouble.

Senator BURTON. That is true even when you are dredging?

Mr. TAYLOR. Yes, sir. In our present operations we do not pay any attention to bars that are more than 9 feet below the surface of the water, but if we introduce such a number of large cuts across the bars as will let down the low-water surface of the river, so that bars that are not troubling us now will have to be looked after, we have to dredge more and more bars and go deeper and deeper, and will come by and by to a point where the work will become exceedingly difficult. I do not say it can not be carried to 24 feet, but I do say we will find it tremendously difficult to do it and keep that depth.

Now, to do anything like that, Mr. Chairman and Senators, to get even 14 feet, it will be necessary, I think, that we shall reduce the quantity of sand which is eroded from the banks and deposited on the bars. Every revetment that is put in and holds its place stops that much caving and cuts off that much of the supply upon which the bars are fed. If the caving banks were all revetted the bars would be starved out; they would not disappear entirely, but they would be reduced to such small proportions that you would have a deep natural channel. I believe that if the banks were all revetted the river would become navigable to 14 feet without any other sort of an improvement at all. If we have in mind the probability of looking for further depths in the Mississippi River, the course we want to pursue is to greatly increase the number of revetments, with the view of diminishing the activity of bar building. It is certainly true that the revetment of caving banks diminishes the activity of bar building. There is a stretch of river called Plum Point reach, about 75 miles above Memphis, where a large number of revetments were put in years ago and a large number of them are yet there. For 40 or 50 miles below that reach there has been a noticeable diminution of bars. They are of less height than they once were, and I think the evidence is clear that they have shrunk in consequence of the revetments that have been put in above them; and there is nothing to account for it that I know of except the diminution of bar-building activity due to the revetments in Plum Point reach.

If we ever expect to greatly increase the depth in the Mississippi River below Cairo, revetments will be necessary. Nothing can be more certain than that; and inasmuch as every revetment that is put in now to protect the levee at a critical point will contribute at once to the diminution of bar-building activity and also to protect the levee and so do service in two directions at once, I say, gentle-

men, that I know of no place in all the United States where you can put \$4,000,000 with more certainty of useful results than right there.

Senator BURTON. Do you think this \$4,000,000 which you have asked for is necessary for the protection of the work already done by the Government?

Mr. TAYLOR. Yes, sir; it is.

Senator BOURNE. And for protection of property on the side?

Mr. TAYLOR. Yes, sir.

Senator BOURNE. And also looking toward the future improvement of navigation by deepening the river?

Mr. TAYLOR. Yes, sir.

Senator BURTON. What share of the sand bar building material, as you term it, in the river below Cairo originates from the caving of the banks, and what share comes in from above? You never made any calculation on that I suppose, but your statement gives less importance to that which flows in from above Cairo than some have given to it.

Mr. TAYLOR. I know it does, but I think I am right there.

Senator BURTON. Now, reducing it to fractions, approximately, what would you say it was from the Mississippi River above Cairo and what share developed in that section?

Mr. TAYLOR. I should say, without any hesitation, although you must know that this is largely conjecture, yet I should say without hesitation, that not 1 per cent of it comes from above Cairo.

Senator BURTON. Comes in from above.

Mr. TAYLOR. No, sir.

Senator BURTON. How about that material which is here? What rate of progress does it make downstream?

Mr. TAYLOR. It is moving downstream all the time. I am not able to say at what rate, or how many miles a year, but the caving, as a rule, begins at the upper end of the bend and increases in activity as it approaches the lower end, so that the result of the year's work is to move the bend downstream a little. In this way the bends are all the time moving downstream slowly.

Senator BURTON. You would not be able to give any estimate of the rate?

Mr. TAYLOR. No, sir.

Senator BURTON. And the place of that that goes down is supplied by that that comes in from above?

Mr. TAYLOR. Yes, sir.

Senator BURTON. Now, as I understand you on this problem of the improvement of the navigation of the river, you think the only effective way in which to obtain a material increase in depth is by revetting the banks?

Mr. TAYLOR. Yes, sir. That is necessary, in my opinion.

Senator BURTON. You would eliminate dredging?

Mr. TAYLOR. You could not eliminate dredging for the present.

Senator BURTON. I mean as an absolute reliance?

Mr. TAYLOR. Yes, sir.

Senator BURTON. Of course you have to have dredging.

Mr. TAYLOR. Yes, sir.

Senator BURTON. You do not think you would get 5 additional feet by dredging? You have 9 now.

Mr. TAYLOR. No, sir. I do not think you could get 5 additional feet by dredging. We tried two experiments; one last year and one the year before. We experimented on two or three bars to see if we could get 14 feet by dredging. We made a success on two of them and a failure on the third. The result of the experiment as a whole was to indicate that an attempt to get 14 feet by dredging in the present condition of the river would be uncertain and unreliable.

Senator BURTON. To increase the depth by spur dikes or by contracting the width of the channel would be a very different question.

Mr. TAYLOR. You could not do that.

Senator BURTON. Or by dams or anything of that kind?

Mr. TAYLOR. I do not think so.

Senator BURTON. Now we come to the point of deepening the channel by revetment, the most reliable, but a very slow process.

Mr. TAYLOR. Bound to be slow; yes, sir.

Senator BURTON. And it would take a good many years?

Mr. TAYLOR. A good many years, and slower and slower as you went on. I would like to say this before I forget it; and that is we could give you 10 feet now without any trouble in two years. My opinion is that it would be a wise thing for Congress to do to make a requirement of 10 feet, and I think it would be a good thing to put in the bill this year that the work shall be conducted with a view to obtaining 10 feet from Cairo down within the next two years.

Senator BURTON. One foot additional to the present depth?

Mr. TAYLOR. Yes, sir.

Senator BURTON. Would you require any additional equipment in the way of dredges for that?

Mr. TAYLOR. I do not believe we would.

Senator BURTON. In going up and down the river are there complaints of shallow depth?

Mr. TAYLOR. No, sir.

Senator BURTON. The sole appeal is for the protection of property?

Mr. TAYLOR. That is the only outcry now.

Senator BURTON. The applications that are coming now do not ask for a greater depth of water?

Mr. TAYLOR. No, sir.

Senator BURTON. Never have, have they?

Mr. TAYLOR. Oh, yes.

Senator BURTON. That was where there was a shallow place on a bar or something of that kind, they would ask you?

Mr. TAYLOR. Yes, sir.

Senator BURTON. Conceding your claim for \$4,000,000 as a maximum amount, could you economically spend any more than that on this river?

Mr. TAYLOR. No, sir; I think not.

Senator BURTON. Could you ever, in years to come?

Mr. TAYLOR. I do not know, but not for a few years to come.

Senator BURTON. Four million dollars a year you regard as the maximum amount that you could economically spend on the river?

Mr. TAYLOR. Yes, sir; I believe it is.

Senator BURTON. What is your opinion as to the shallow-draft and deep-draft navigation in that locality?

Mr. TAYLOR. My opinion is that this country has a great lesson to learn as to the value of shallow-draft navigation. Of course there is great economy in deep-draft navigation—the value of a channel for navigation increases with the square of its depth, I suppose you might say—but at the same time there is a great value in shallow navigation. I look forward to the time when we shall have in this country a vast system of internal waterways of all depths, from a few inches to many feet, all of which will be made useful and profitable.

I have been watching for two or three years an experiment in the Mississippi Valley with gasoline motor boats. The boat consists of a barge not much longer than this table and not more than twice as wide as this table—just a box like a piano box; a water-tight box not more than 3 feet high. The gasoline motor at the stern is about as large as an automobile, and propelled by some sort of a gasoline engine. I have seen more of them about Vicksburg than elsewhere. These boats load up 2 or 3 or 4 tons of freight—maybe more, I do not know how much—and go up the bayous of the Yazoo Basin and the little streams there through the narrow, shallow channels that intersect that basin. They do not draw more than a foot and a half, and they seem to be doing a good business and increasing rapidly. They are like what you might call an aquatic truck. One man does the whole business. The owner sits in the stern and is captain, pilot, and engineer all in one.

Senator BURTON. In the navigation below Cairo, with the exception of the coal that comes down the Ohio River, there is practically no long-distance navigation, is there?

Mr. TAYLOR. Not much, although I run across, every once in a while I run across shippers who tell me that they shipped their freight on the Mississippi upstream as well as down. I happen to know a member of a large drug firm in St. Louis who told me the other day that they were shipping all their oriental stuff, their olive oil, barks, essences, and drugs that come from the Mediterranean and Eastern countries entirely by water—by ocean vessels to New Orleans and from there to St. Louis by river.

Senator BURTON. They have no through passenger boats now?

Mr. TAYLOR. There are no through passenger lines from St. Louis to New Orleans.

Senator BURTON. They ship on freight boats?

Mr. TAYLOR. Yes, sir.

Senator BURTON. There is very considerable traffic south from Memphis to Helena, is there not?

Mr. TAYLOR. Yes, sir.

Senator BURTON. And from Vicksburg to Natchez?

Mr. TAYLOR. Yes, sir. There are lines of boats from New Orleans to Memphis that carry passengers, and there is a line from Memphis down to Vicksburg and lines from Vicksburg to New Orleans.

Senator BURTON. There are no through passenger or freight boats from Cairo?

Mr. TAYLOR. I can not say about that.

Senator BURTON. You are familiar with the line at New Orleans that they call the Mississippi Valley Transportation Company?

Mr. TAYLOR. Yes, sir.

Senator BURTON. Up to just a few years ago they carried considerable freight down the river?

Mr. TAYLOR. Yes, sir.

Senator BURTON. When was it at its height?

Mr. TAYLOR. I think its greatest development must have been between 1870 and 1880.

Senator BURTON. The same company?

Mr. TAYLOR. The same company, I think so. These boats were at their greatest activity before the Mississippi River Commission commenced its work.

Senator BURTON. In what way did they carry their freight? I think the committee would like to know.

Mr. TAYLOR. They carried their freight in barges, handled by sternwheel towboats—a number of barges by one towboat. They had no trouble in taking down 50,000 bushels of grain in one tow.

Senator FRYE. Any of those gasoline boats on the Mississippi River?

Mr. TAYLOR. Not on the Mississippi River proper, they are too little for that.

Senator GALLINGER. Have you given any thought to the type of barge used in Germany? I think it is 206 feet long, carries 600 tons, with a draft of $5\frac{1}{2}$ feet.

Mr. TAYLOR. I have given no thought to it at all.

Senator BURTON. The usual barge is something over 1,000 tons.

Senator GALLINGER. They have one type of 600 tons.

Mr. TAYLOR. I have seen them on the river Rhine, that is all I know about it.

Senator GALLINGER. What do you think of the possibilities of using them on the Mississippi River?

Mr. TAYLOR. I do not see any reason why they should not be used to a very great extent. There is a channel of 9 feet from Cairo to New Orleans, and 9 feet is sufficient for highly profitable navigation, in my opinion.

Senator BURTON. What is the reason commerce will not use it?

Mr. TAYLOR. There are a whole lot of reasons. The answer to that is almost as comprehensive as another committee is expected to give why fines have increased. The main cause, in my opinion, is want of confidence.

The CHAIRMAN. In the river?

Mr. TAYLOR. Yes, sir; in the permanence of the improvement.

Senator BURTON. That is, if they had 9 feet permanently they could well—

Mr. TAYLOR. Yes; but that 9 feet is dependent upon appropriations made by Congress from year to year.

Senator BURTON. Congress had appropriated enough for the other years?

Mr. TAYLOR. They have done so of late, but not always in the past. Shippers are not sure they will in the future.

Senator BURTON. I think, so far as dredging is concerned, you could have confidence in that.

Mr. TAYLOR. River navigation depends upon individual endeavor. To build a fleet of boats to navigate the Mississippi River profitably would cost several millions of dollars, and it is not surprising that men hesitate to do it. It is not strange, in view of the history of the river. Thirty years ago there was a great clamor for the improvement of the channel. The Mississippi River Commission came in with a blare of trumpets; they were going to get 8 feet right away. That goes back, I expect, beyond the active recollection of you gentlemen about this subject.

The CHAIRMAN. Not beyond mine.

Mr. TAYLOR. Not beyond your recollection if you were giving attention to it at that time. If you had time, I would like to give you a little bit of history there; it is interesting. As soon as the Eads jetties had been successfully opened in 1878 by the contraction of the channel and the increase of the flow over the bar

people said at once, Why can not we apply that principle to the whole river? Captain Eads thought we could. He said we could; and Captain Eads's word went a great way in that day. The Mississippi River Commission was created upon the faith of the country in Captain Eads. He was one of its members at the beginning. It was called Eads Commission for some years.

The CHAIRMAN. Let me remind you right there that Captain Eads was going to cross the Isthmus; he was going to send the ships over on rails.

Mr. TAYLOR. I know he was. I watched that project some, too. Captain Eads wrote the first report. He formulated the original plan, which was for the improvement of the channel by concentration of flow solely and alone. He proposed to bring the low-water width of the river to approximately 3,000 feet along its whole course. This was to be accomplished by holding the caving banks by revetment and by building up banks where the river was abnormally wide by deposits of sediment produced by dikes. We started in on that plan, and selected a place called Plum Point reach, 25 miles above Memphis, and another one called Lake Providence reach, about the same distance above Vicksburg. They were the worst places in the river. We started in with high hopes, and were going to have 8 feet to Cairo in short order. But we encountered all sorts of unexpected difficulties. We did not know how to build revetments for such conditions. We started out with mattresses about 300 feet long and 125 feet wide. Those would do very well on the Missouri, but they would not do down there. We gradually increased them in size and improved them in construction, but for several years the work of revetment was so unfortunate that in 1884 Congress prohibited any further revetments on the Mississippi River.

Senator GALLINGER. When was that, Judge?

Mr. TAYLOR. I think that was in 1884. The Secretary of War construed that prohibition to mean that we could not even repair those we had, and we lost millions of dollars because of the prohibition. But it was soon withdrawn.

Senator BURTON. When was it changed?

Mr. TAYLOR. I think it was in force two years, but I am not certain whether it was two or four.

The CHAIRMAN. I think it was two years only.

Senator BURTON. That is entirely new to me. It was before my time. Do you mean that there was an express prohibition of revetment by Congress in making an appropriation?

Mr. TAYLOR. Yes, sir; an express prohibition of revetment in the appropriation bill.

The CHAIRMAN. Senator Burton, the evidence justified it at the time.

Mr. TAYLOR. There was a good deal to justify it. Then, in

regard to what we called contraction work, the dikes that were built upon the bars to narrow the channel. This contraction work was surprisingly successful at the start. We obtained some prodigious deposits of sediment in the chutes and bars where we were trying to build up land. I have known as much as 30 feet of deposit to be made in one season as a consequence of permeable dikes that we set up.

The CHAIRMAN. On top of the dikes?

Mr. TAYLOR. No; below the dikes. But these dikes had a bad habit of doing their work wonderfully well until they built up the deposit to the point where it became most important that they should continue to do it, and then they would quit and let the floods go across, cutting into the deposits that had formed and making little channels across them. Then, if the dikes were a little too high, the drift coming down the river would break them off, and if they were a little too low the water would go over them without making the deposits, so that part of the work proved to be very, very difficult. And yet, with all those embarrassments, Mr. Chairman, we did make substantial and useful headway in developing the channel at Plum Point Reach and Lake Providence reaches. We did demonstrate that the theory upon which we were going was sound in all its parts.

Where the work was put in and kept in; where the revetments on the banks held; where the width was narrowed to 3,000 feet, we got an immediate improvement of the channel. We were working then for 8 feet, and we got 8 feet through the improved reaches at Plum Point and Lake Providence. But as we went along the expense increased enormously; we estimated revetments at the beginning to cost \$12 a running foot. We improved our revetments as they never had been improved in the world. Our engineers acquired a skill in making and sinking mattresses that never had been acquired before. Where we began with mattresses 300 feet long and 125 feet wide, we increased the dimensions to 1,200 feet long and 300 feet wide. There were improvements in manner of construction as important as the increase in size. At last we reached the point where we could hold the banks, but the cost had increased to \$30 a running foot. But in all those years—fifteen or more—we had never been able to get out of those reaches.

Senator NEWLANDS. Get out of those reaches?

Mr. TAYLOR. Yes; those two reaches, Plum Point and Lake Providence. We made an improved channel there, a highly improved channel, and if we could have secured as good a channel from Cairo to New Orleans as we did in those two reaches, our work would have been a great triumph.

Senator NEWLANDS. On an average, how much did you have annually?

Mr. TAYLOR. I should say on a rough average, Senator, something like two millions a year.

Senator BURTON. For the first few years it was several hundred thousand in excess of that.

Senator NEWLANDS. And you now think you could spend \$4,000,000 advantageously?

Mr. TAYLOR. Yes, sir.

Senator NEWLANDS. Do you think that would be enough for the next ten years?

Mr. TAYLOR. I believe so. As I was saying, we spent all our money in Plum Point and Lake Providence reaches, and we made an improved channel there; that much was of little value. The commercial interests on the river became discouraged. The men who owned the steamboats and barges were waiting for the improvement of the channel, waiting and waiting, and it did not come. It did not do any good to have a good channel for 20 miles at Plum Point and 20 miles at Lake Providence while there were bars elsewhere. The old steamboats and barges were wearing out, and their owners did not dare to build new ones. We made a careful estimate of how long it would take us to carry this kind of improvement to Cairo, and we found that at the best we could hope to do, considering the supply of material, the work to be done, and what we supposed would be the possible appropriations by Congress, it would take fifty years at least. That would not answer the purpose of commerce. Those were dark days. For several years the commission was in a position where it could have been accused of having thrown away millions of dollars in the Mississippi River without any results. For several years I felt like I was sitting on a powder magazine and didn't know what day some enterprising newspaper man might not ransack the records and show us up to be a set of utter incompetents. Just at that time there came into view the hydraulic dredge which had lately been introduced in this country, and the thought came to us that we might, after all, with the help of the dredge solve this problem of a channel.

I remember having said once in a speech somewhere that, as for this idea of dredging bars, a man might as well undertake to lower a flood by carting away the water as to handle the Mississippi sand bars with dredges. We had a very bright engineer at that time in the fourth district at New Orleans. We also had a hard problem to deal with at the mouth of Old River to keep that channel open to the commerce of Red River, and we had been trying to do it with a dredge. The mud in that river is like soft soap and as fast as we dipped it up and put it on the bank it would run in again. We sent Captain Millis around the United States to study the subject of hydraulic dredges, and as a result of that trip he designed a dredge to be used on the Red River. That dredge was a wonderful piece

of machinery, and we have never had any trouble since keeping the mouth of the river open for navigation. Then, in view of the success of Captain Millis, we went to work and built an experimental dredge for trial on the bars of the Mississippi River. One of the members of the commission designed it and we called it the *Alpha*—a very good name, the first of its kind. The result of those experiments were so successful that we were encouraged to go further. It was manifest that the success of the work would depend upon being able to get through a bar so quickly that the current could take possession of the cut and keep it open before it would fill up. We called to our assistance the three best engineers of that class in the United States. We took them on the boat and took them down the river and we showed them what we had to do, and spent several days in consultation. We said, "What do you think you can do under these conditions with a hydraulic dredge? We want you to make us a dredge just as powerful as machinery can be to float in this water. We want to find out how quickly it is possible to cut through a bar." We said, "We want each one of you to give us a design for a hydraulic dredge for this work with an estimate of the cost at which you are willing to undertake to build it, and we will give a contract to one of you. We want to make certain specifications ourselves. We want the dredge to be capable of handling at least 1,600 cubic yards of sand an hour and transporting it a thousand feet through a pontoon pipe; the boat to have a draft not to exceed 6 feet and a width not exceeding 40 feet; we want each one of you to design a dredge which he thinks will have the best possible adaptation to that work, and we will take one of them—not necessarily the cheapest one, but the one which we think will do our work the best and most advantageous to buy, counting price as one consideration, and we will give each one of the unsuccessful bidders \$1,500 for making his plans." In that way we built the *Beta*, the second dredge, and that boat on its trial accomplished the astonishing feat of taking up and transporting to a distance of 1,000 feet 6,000 cubic yards of sand in an hour. I hesitate somewhat to make this statement, because I am speaking entirely from memory, and my memory of figures is very unreliable. But that is my recollection. At all events, it was something phenomenal—something which had never been heard of before. It settled the question. It was then obvious that it was possible to make a dredge boat that would cut through a bar so quickly that the water could take possession of the cut and flow through it before it would begin to fill up; and that was the beginning of dredging on the Mississippi River. I slept far better for a good many nights after that.

Senator BURTON. When was the *Beta* built?

Mr. TAYLOR. I am the worst man on dates there ever was in the world.

Senator BURTON. Do you remember, Colonel Bixby?

Colonel BIXBY. I do not remember; it was long before my day.

Mr. COOLEY. 1896 or 1897.

Mr. TAYLOR. Mr. Cooley is a walking encyclopedia of facts, and he undoubtedly knows better than I do.

Senator BURTON. You stated you do not think any material increase in depth would be obtained by dredging. Are you sure that there will not be as much further advance in the make of dredges and the amount of material that they will be able to handle, and that they will accomplish just such astonishing results as the *Beta* did before?

Mr. TAYLOR. I think there might be.

Senator BURTON. Is there any limit to size?

Mr. TAYLOR. There is a limit to draft, of course. A dredge boat used on a bar must be of such shallow draft that she can get on the bar and get through the river; but a dredge boat might be made twice as great as the *Beta*.

Senator BURTON. You would still have that problem of pools, with bars above?

Mr. TAYLOR. Of course.

Senator BURTON. And the difficulty of handling that enormous mass of material?

Mr. TAYLOR. Yes, sir. Since that time we have built eight smaller dredges. As we built the *Beta* as an experiment, she was not very well designed for active work, although she has done a great deal of good work since and is still serviceable. The dredges we have now, the best ones, handle approximately 2,000 cubic yards per hour.

The CHAIRMAN. Did we not import one of those dredges?

Mr. TAYLOR. No, sir.

Senator GALLINGER. That was at Galveston.

Mr. TAYLOR. I think there was one or more imported for use at Galveston. We have been improving these dredges all the time; the last one built has always been the best, and we expect to improve them still further.

One of the members of the commission was abroad last year in attendance upon the navigation congress at St. Petersburg, and while abroad he was authorized to spend several months on the continent in the study of the latest developments in suction dredges, and he brought with him a large mass of very valuable material, by the aid of which we are expecting to build another dredge which will be superior to any we now have.

The CHAIRMAN. What solidity is there to the sand on a bar?

Mr. TAYLOR. It varies. It depends largely on how long it has been there. Sometimes the bars are very hard, but the average bar is quite soft. In a few places on the river the bars contain a good

bit of gravel and they are quite hard. But such bars are not common. There is one thought, Mr. Chairman, which I want to express in reference to the deepening of the river by the building of revetments. I think the river itself teaches a lesson on that point, from which we can get some sound deductions. The river in its lower reaches has by nature a deep channel. There is no necessity for any improvement in depth, except at one or two localities, anywhere below Red River. Now, in my opinion that is to be attributed mainly to two causes. The first is the continuity of flow in the same path, and the second resisting power of the banks. I ought really to reverse the order of those causes. In the lower reaches of the river the banks are formed by deposits of finer sediment than that deposited in the upper reaches. This forms a hard, tenacious soil which erodes slowly. This greater permanence of the banks keeps the current flowing in the same path and it cuts its channel deeper and deeper.

Now, by revetment, we imitate to a certain extent that condition. We increase the relative resisting power of the bank, and in doing that give the river a chance to scour its bed and make itself a better channel. So I look to revetment first for a reduction in the amount of bar building material which travels down the river; and second, for a greater perseverance of the river in the same line of flow from year to year. These two causes together will be sure to give us an improved channel. As to how much, I don't know. I have no doubt it will be 14 feet, with complete revetment of the caving bends.

Senator BURTON. Speaking of revetment in the earlier work of the commission, you limited the location to those two places where it had an immediate effect in the regime of the river and navigation?

Mr. TAYLOR. Yes, sir.

Senator BURTON. This revetment at Bolivar was the first exception?

Mr. TAYLOR. Yes, sir; the first exception.

Senator BURTON. That was about 1888?

Mr. TAYLOR. That was the date; but I was not right in saying what I did in answer to your question. The Bolivar revetment was the first one put in to save a levee, but we had put in some at Hickman and Columbus, in Kentucky, at an earlier date to save them from the attacks of the river.

Senator BURTON. Your method of selection is where it will save the levees?

Mr. TAYLOR. Yes; to meet emergencies, where it will save the levee or prevent a cut-off.

Senator BURTON. You are speaking of some causes of the decadence of traffic; what are some of those?

Mr. TAYLOR. What I have said pretty nearly covers the subject. The old boats have worn out, and there is no possibility of the restoration of traffic on the Mississippi except by building new boats at a large outlay of capital. The people who would do that sort of thing are distrustful of the permanence of the channel and are afraid of the railroads.

Senator BURTON. The railway system is very different from what it was forty years ago?

Mr. TAYLOR. Yes, sir; very.

Senator NEWLANDS. What is the possibility of restoring river transportation? It is practically dead now.

Mr. TAYLOR. I know it is. I think it can be restored, but its restoration, in my opinion, requires two things: First, confidence on the part of the people; and in the second place, some sort of protection against ruinous railroad competition. I think the present laws which allow the railroads to cut rates to any extent to meet water transportation are not right. I think there ought to be some limitation upon the right of railroads to cut rates as against water transportation.

Senator BURTON. Speaking of that confidence. You say the Mississippi Valley Transportation Company was really doing more before the commission took up the work at all?

Mr. TAYLOR. Yes, sir; I think it was.

Senator BURTON. I see no lack of confidence there.

Mr. TAYLOR. It had embarked upon an enterprise—

Senator NEWLANDS. They had the railway competition at that time, didn't they?

Mr. TAYLOR. They took the river as it was.

Senator BURTON. The transportation company was building new barges and obtaining new tugs and had a very large number of them clear down to the beginning of this century, and they sold out one by one and finally sold out all of them in 1904.

Mr. TAYLOR. They may have sold out finally in 1904. I thought they had substantially quit before that. There is another thing to be said about it, and that is that the men who were behind that enterprise switched off and became interested in other lines of business that were much more profitable and they let the barges go. There was a great boom in St. Louis about that time in developing trust companies, and Mr. Haavstick became interested in them, and he could very well afford to let his barges go.

Senator BURTON. In regard to the railroad competition, what do you say to a statute which provides that when a railroad has lowered a rate on the line by rail in order to compete with river transportation that it can not restore that rate unless the Interstate Commerce Commission approves and finds that the rate was not lowered merely to cut out the water transportation?

Mr. TAYLOR. I think that would be wise.

Senator BURTON. Would you go so far as to give the commission authority to make the minimum rate?

Senator MARTIN. If the long and short haul clause was absolute and did not have the exception, that would cure the trouble. The long and short haul clause is subject to exception. Now, wherever there is water competition, then they change the rate to suit themselves, although for a shorter distance they will charge not half as much.

Senator BURTON. The Waterways Commission expresses the opinion that it had been carried further than it was originally intended.

Senator MARTIN. If that clause of the law was free of that exception and made absolute and unconditional, it would meet the difficulty of the situation.

Senator BURTON. That is a pretty big problem, Senator Martin.

Senator MARTIN. It is a large problem.

Mr. TAYLOR. I think it would encourage commerce if you would put in the law now a direction that the 10 feet be obtained below Cairo within two years. It would signify that the Government had taken a step forward which would go a long ways to gain the people's confidence.

Senator BURTON. Is not the decrease in these grain shipments due to the fact that flour mills have been established along the route by which the grain goes, and that it is different right now from what it was then?

Mr. TAYLOR. I think that may be so.

Senator BURTON. Is not this a pretty important factor in the situation—the absolute lack of terminal facilities?

Mr. TAYLOR. It is a very important factor, I think; highly important.

Senator NEWLANDS. Do you think if the improvement was made there to give 10 feet and was assured on the river, that the people themselves would establish these terminal facilities and build the steamers?

Mr. TAYLOR. I don't know just how far that would go. That would very much encourage them to do it, but just how far they would go I do not know. The towns and cities along the river, I think, would be encouraged to build wharves and terminal facilities. Those are the parties that ought to build them; the cities and towns along the river ought to make their own terminal facilities. You could hardly expect the shipper to do it.

Senator STONE. Do you know what the comparative difference would be of freight rates on the river and by rail?

Mr. TAYLOR. No, sir; I am not informed on that subject.

Senator STONE. About the matter of making the provision so

that the levees bordering on the river would be taken care of by the riparian owners—you expressed yourself several years ago before the Rivers and Harbors Committee on that?

Mr. TAYLOR. If I understand your question, my answer would be this: We have long been looking forward to the time when the property owners would be able to take care of the levees there themselves without any help from the Government. That time has come with respect to one large levee district. The upper Yazoo Levee District has taken care of its own levees entirely for four years, and has expended, I think, in that way something over \$2,000,000. There are other districts, especially some on the west side of the river and some in Louisiana that may be able to do that within a very short time. In the last two or three years the levee authorities have very generally expressed the opinion that if we could take care of the banks and protect the levees against the encroachment of the river by caving, that they could take care of the levees.

Senator STONE. Now, if this large appropriation is made that you ask, ought not the commission begin insisting on that?

Mr. TAYLOR. I think we ought.

Senator STONE. That the communities take charge of the levees?

Mr. TAYLOR. Yes, sir; I think so.

Senator BOURNE. Do you mean the construction or maintenance?

Mr. TAYLOR. Both. We have always done that to the greatest extent possible, and with few exceptions the people have responded, as we thought, to the extent of their ability. There are some instances where they did not, but in very few localities.

Senator STONE. Would you deem it wise to insert a provision prohibiting the commission from using the money for levees?

Mr. TAYLOR. In this bill?

Senator STONE. Yes.

Mr. TAYLOR. Oh, no; I would not do that. Let me tell you about that. There are some places in which the levees ought to be built higher, where the riparian owners are very feeble, and yet where the levees ought to be made higher, and some places where the levees ought to be extended where none have been built yet. Two of these places are at the foot of two great basins. One of these is the St. Francis, which begins a little way above Cairo and extends down to a little above Helena. The St. Francis River flows down that basin and empties into the Mississippi River a little above Helena. The foot of that basin has been left open in order to let the surplus water escape into the river, and it must always be left open; but the levees have not been extended down as near to the foot of that basin as they ought to be. There are a few miles of levee that ought to be built there in which the Government will have

to assist. The citizens can help, but the Government will have to assist if it is to be done within any reasonable time. A similar condition exists at the foot of the Yazoo Basin. The Yazoo River formerly emptied into the Mississippi at the foot of that basin, just a short distance above Vicksburg, but in the recent years the Government has diverted the Yazoo from its former course and carried it down in front of the city of Vicksburg. There is no reason now why the levees should not be carried down close to the city of Vicksburg, and it ought to be done; and there will have to be some help there. There is another contingency that might arise, Mr. Chairman, which would require the expenditure of a large amount of money on the levees below Red River. There is a provision in this bill that the commission shall examine and report upon the feasibility and desirability of divorcing the Red River from the Mississippi. That means building a dam across Old River, which connects Red River with the Mississippi so that all the water of the Mississippi must go down between the banks to the Gulf. As it is now the Mississippi floods divide at Old River, and part of the discharge goes down the Atchafalaya to the Gulf. There has been for many years a strong demand to close that mouth. It has been awaiting the completion of the lock at Plaquemine which lets the Red River commerce into the Mississippi at that point. Now, that lock has been completed, and the demand for the divorce of the Red River from the Mississippi has become active and urgent. That division ought to be made some time. Whether in the near future or not, is a question. If it should be, it will produce a condition of things which will require a considerable increase in the height of the levees from there down to the Gulf.

Senator BURTON. This water, when the Mississippi is high, which flows through Old River and down the Atchafalaya, would flow directly down the Mississippi and raise the level of the water very much.

Mr. TAYLOR. Yes, sir; that is what would happen. We know by experience that two or three times in a century, at long intervals, extraordinary floods do occur—floods like they had in Paris, that eclipse all former records for long periods of time. Now, with the mouth of Old River closed by a dam and the levees remaining as they are now such a flood as that would inundate the whole lower country.

Senator BURTON. Can you state briefly the reason for closing that?

Mr. TAYLOR. It is mainly to relieve the Atchafalaya Basin from Mississippi flood water, and so protect the lands in that basin, or, rather, make their protection and reclamation easier.

Senator STONE. Leaving this out, can you give an estimate of how many miles we would fill out to build levees?

Mr. TAYLOR. Of new levees not more than 50 miles, I think.

Some of the present levees are lacking in the necessary height and strength for entire safety. We have a standard—I do not know how interesting all of this is to you gentlemen—we have a standard height which the Mississippi River Commission has established, and which is regarded as safe, and that is that the crown of the levee shall be 3 feet above the highest known water in that locality. I will explain that a little. The flood level or flood surface of the Mississippi River is a very irregular line; it does not follow a defined and continuous slope.

Senator BOURNE. It depends on the topography of the country, does it not?

Mr. TAYLOR. It is subject to a great many causes, and we have this method of keeping track of it. At every great flood, there is an examination made of the river along the banks by men in skiffs, who drive nails in trees every mile or so at the water surface, and that gives us a record of the flood height at those particular points. Five miles below it may be quite different, and five miles above it may be quite different again; so that the top of the flood is a sort of undulating line; and as the levee is built to a height of 3 feet above that watermark, it is 3 feet above the highest known water in that locality. There are some places in the levee that are below that height, and they must be brought up. How much the Government will have to help on that I do not know.

Senator BURTON. Of this 50 miles you would expect at least half to be paid by the locality, would you not?

Mr. TAYLOR. I should think so; yes, sir.

The CHAIRMAN. You will be here to-morrow, will you not, Judge Taylor?

Mr. TAYLOR. I will remain here, Mr. Chairman, if I can be of any service to the committee.

Senator BOURNE. What is the general process of local contribution in the way of cooperation? Do they bond their land?

Mr. TAYLOR. It is done in this way: The local communities have organizations authorized by statute, and they raise money by taxation. They issue bonds, too, and nearly all of the districts are bonded now for as much money as they can borrow. The work on the levees is parceled out by consultation between the United States district officer and the local levee officer.

Senator BOURNE. Under the direction of the United States district officer?

Mr. TAYLOR. We allot, for instance, say, \$100,000 for the lower Yazoo district. The United States officer there knows that he has that amount to spend there. The local engineer of that district knows how much he can spend. They meet in consultation and go over the ground and agree that the United States officer shall take

this much of the work and the local engineer the rest. It is all done to the approval of the United States district officer.

Senator BOURNE. The new land formed or reclaimed, does that go to the levee districts?

Mr. TAYLOR. That goes to the riparian owners.

Senator BURTON. The State of Louisiana has a tax over the whole State, do they not?

Mr. TAYLOR. Yes, sir. There is a tax extending over the whole State to a certain amount. That is the only State in which there is anything of that kind.

The CHAIRMAN. The committee will now stand adjourned until 10 o'clock to-morrow morning.

(Accordingly, at 4.40 p. m., the committee adjourned until to-morrow morning, Wednesday, March 2, 1910, at 10 o'clock.)

APPENDIX D.

THE MISSOURI RIVER.

WEDNESDAY, MARCH 2, 1910.

COMMITTEE ON COMMERCE,
UNITED STATES SENATE,

Washington, D. C., *March 2, 1910.*

The Committee on Commerce of the United States Senate met, pursuant to adjournment, at 10.30 a. m.

Present: Senators Frye (chairman), Nelson, Gallinger, Penrose, Perkins, Bourne, Burton, Martin, Stone, and Simmons.

The CHAIRMAN. The committee will please come to order.

The Senator from Oregon wishes to ask Mr. Cooley a question, and the chair hopes that in answering Mr. Cooley will be as brief as he possibly can.

Senator STONE. Mr. Cooley does not seem to be here, Mr. Chairman.

The CHAIRMAN. Mr. Cullom, do you wish to say anything now about the Chicago matter?

Senator CULLOM. I do not want to discuss the subject at all except the provision relating to Illinois, and I would prefer to do that after the others are through.

The CHAIRMAN. Suppose you do it now; it will relieve you from attending on the committee hereafter.

Senator CULLOM. If there is anybody else present who has anything to say, I would prefer that they make their statements first.

Senator STONE. There is present this morning Mr. Fox, an engineer who has had a large experience on the Missouri River. He wants to return today, and I would like some time, as soon as it is convenient for the committee to hear him, to let him proceed. He can do so after Senator Cullom has made his statement.

Senator CULLOM. If he is here, let him go on right now.

The CHAIRMAN. Very well. We may just as well take up the Missouri River one time as another. We already have some evidence in relation to it from gentlemen who have been before the committee.

Senator STONE. Colonel Bixby spoke something about it.
The CHAIRMAN. So that we will hear the engineer now.
Senator STONE. This is Mr. Fox, of Kansas City.

STATEMENT OF S. WATERS FOX.

The CHAIRMAN. What is your name?

Mr. FOX. S. Waters Fox.

The CHAIRMAN. What is your business?

Mr. FOX. A civil engineer.

The CHAIRMAN. Are you a government engineer?

Mr. FOX. No, sir.

Senator BURTON. Have you ever been in the employ of the Government?

Mr. FOX. I was employed for twenty-four and one-half years on the Missouri River work.

The CHAIRMAN. On Missouri River work?

Mr. FOX. Yes, sir; I first entered the service, Mr. Chairman, in September, 1878, and for a time was engaged under (then) Maj. (now retired Brig. Gen.) Chas. R. Suter, in designing some boats for him at the St. Louis office, and then I went on the lower Mississippi River in charge of a party to collect physical data of the stream from Cooks Point to Arkansas City. In the following May, 1879, I was sent on to the Missouri River in charge of a party to expend two appropriations, one at Glasgow and another at Cedar City, Mo. I was continuously in the employ of the Government in charge of works at various points on the Missouri River from that time until 1903, when I resigned in order to go into civil life and engage in the practice of my profession as a civil engineer.

The CHAIRMAN. The committee will hear what you have to say with reference to these items about the Missouri River. You have read them, have you not?

Mr. FOX. Yes, sir. If you will pardon me, I want first to deliver a message which, as a representative of the Kansas City Commercial Club, I was asked to deliver to the committee by the president of the club, Judge W. T. Bland. Kansas City is now engaged in raising a million dollars for a boat line on the Missouri River, and I am assured in a way that enables me to assure you that that money will have been raised by the end of this month—the million dollars. Something like \$450,000 of it had been subscribed when I left Kansas City on Friday last. And they have undertaken, in a way that insures success, to raise the balance of that money before the end of this month. There is absolutely no doubt but that the full amount will be subscribed and devoted to establishing a line of boats upon the Missouri River.

The CHAIRMAN. Between what points?

Mr. FOX. I think between Kansas City and St. Louis. Whether they will extend their operations above or below those points I do not know.

It is possible that they may have an auxiliary plant that would run up the river as far as St. Joseph or Omaha, but I am not sure as to that.

Senator GALLINGER. What would be the character of the boats?

Mr. FOX. That has not yet been determined, but it will be. The boats will be builded upon the lines that the most thorough investigation into the subject would seem to indicate as the best.

Senator GALLINGER. Do you know what the contemplated draft of the boats will be?

Mr. FOX. They will probably arrange for a draft of 6 feet anyway. That would be the most obvious thing.

Senator GALLINGER. Will they be steamboats or barges?

Mr. FOX. That I am not authorized to say.

Senator BURTON. Will you be good enough to repeat the last sentence? They will probably be what, did you say?

Mr. FOX. They will probably be designed for a 6-foot draft. That means that they can be used on a 3-foot draft, of course, or that they can be used on any greater depth of water that was available.

In this connection I would like to call the attention of the committee to the fact that in 1907 and 1908, when Kansas City had a small line of boats on the river engaged in commerce, they found it practicable to load to something like a 5-foot draft. Now, that is not the measure of what will be found feasible if Congress continue to neglect the Missouri River, or do anything short of permanent, comprehensive improvement of the river. In the period of five years, beginning in 1903, the Missouri River made a phenomenal flood record. The great flood of 1903 attained a height of 35 feet on the Kansas City gauge, or 8.8 feet higher than the disastrous flood of 1881; again in 1904 the river rose to a height of 25.2 feet, and in 1908 a stage of 30.3 feet, or only 4.7 feet lower than the 1903 flood was attained. In point of duration the 1908 flood was phenomenal—it holds the record. Its effect, on that account, in cleaning or scouring out the channel of the river was even more marked than the combined effects of the two previous floods. As a result of these three floods in five years, we have greater navigable depth in the river than previously obtained, or than we can reasonably expect to have in the future. The recurrence of great floods at such intervals is very unusual. With the single exception of the flood of 1844, the only flood of magnitude at all comparable in its effect upon the general conditions with that of 1903 was in 1881, above referred to.

I bring this up because I think we can reasonably expect, in the ordinary course of events, that the channel will deteriorate to some-

thing like its normal condition of depth at low water, which is about 3 feet. That is, boats would find, instead of 5 feet, or 6 feet on the crossings, something like 3 feet. Before the systematic improvement of first reach was undertaken by the commission in 1891 to 1906, there was only 30 inches of water in that stretch of river, in the locality of the mouth of the Osage River, and while that was an exaggerated case, it was a persistent one. And, generally speaking, there were but 3 feet available over the crossings in the Missouri River from Kansas City to the mouth.

Now, I would like to impress upon the committee this idea, that if the development of the 6-foot channel way is to be undertaken in accordance with Major Schulz's project, provision should be made promptly to follow up that work, as he recommends, with such work as will embrace the entire project for the ultimate channel of 12 feet. I regard this as imperative because it is necessary to insure, as far as can be, the permanency of the work involved in developing 6 feet in the crossings. Long study of the question of the improvement of the Missouri River has convinced me of the entire feasibility of getting ultimately at least 10 feet.

The CHAIRMAN. From what point to what point?

Mr. Fox. Kansas City to the mouth, and ultimately, if the work is extended as far north as Sioux City, possibly 12 feet from Kansas City to the mouth. That is to say, I believe that if the Missouri River were improved as far as Sioux City, we would certainly have 6 feet from Sioux City to Kansas City, and as much as 10 feet, and possibly 12 feet, from Kansas City to the mouth.

Senator GALLINGER. Now, excuse me, Mr. Fox. You said a moment ago that it was in contemplation to raise a million dollars to put a line of steamers on with a draft of 5 feet?

Mr. Fox. Six feet.

Senator GALLINGER. If it is contemplated that those steamers should have a draft of only 6 feet what is the need of a 12-foot channel?

Mr. Fox. I thought I made that clear. If we have 12 feet it would enable boats to draw something like 11 feet, of which perhaps 9 feet would be effective displacement due to the load. With a 6-foot channel there would be available only about 4 feet of effective displacement due to load.

The CHAIRMAN. How is it above Sioux City?

Mr. Fox. A 3-foot channel would probably permit of only 1.35 feet of effective load displacement. That is to say, a given unit barge could carry about three times as much on a 6-foot channel as would be practicable on a 3-foot channel, and six and two-thirds times as much on a 12-foot channel; and on a 12-foot channel the unit would carry about two and a quarter times as much as on a 6-foot channel. That is speaking in round numbers.

The CHAIRMAN. How about Sioux City up to Benton—isn't it Benton?

Mr. FOX. Fort Benton; yes, sir. That is susceptible of improvement, and I would say that it would be entirely feasible to get 4 feet up to Benton and maintain it.

It is of great importance that we understand clearly what is involved when we talk of getting a 6-foot channel in Missouri River. I take it to mean that at all times, when navigation is not interfered with by ice, there shall be a continuous channel of reasonable alignment in which no cross section exists where maximum depth of not less than 6 feet obtains for a navigable width. Now, that is very significant when applied to the Missouri River; it means a whole lot to maintain such conditions. In the earlier stages of the work, and until everything has been adjusted under the new regime of flow, there will be temporary engorgements, due to local, accidental causes, of the sediment or detritus which is in transit down the river, and during that period there will be less than 6 feet in the crossings, and even in the bends or pools as well. In the movement and disposition of the immense amount of material which is being continually precipitated into the stream in its unimproved condition, there are all sorts of accidental causes which result in choking up channels, even to the extent of diverting the flow so as to form new channels. These obstructions are often only temporary and, when so, are characterized by the pilots as lumps. The effect of improvement works would be, as time progressed, to make these features more and more ephemeral and of diminishing importance; but, meanwhile, if commerce were actively engaged upon the river, it is more than probable it would be seriously hampered.

Senator BOURNE. How do you mean temporarily? Does the river itself take those out?

Mr. FOX. Yes. They would not become stable.

Senator BOURNE. The river in time erodes them away?

Mr. FOX. Yes, sir; the confined flow of the improved river would take care of them. They would be, so to speak, only tramp bars.

There has been a good deal said here about the material in transit in the Missouri River, and if you will permit me, I would like to say just a word about that. A comparison of the official maps shows that every year the Missouri River erodes about 13 acres per mile of its banks between Sioux City and its mouth, a channel distance of 807 miles. If we assume a bank height of 40 feet that is equivalent to a prism of earth a mile square and about 655 feet deep, or about 687,000,000 cubic yards. Also, it is estimated that about 413,000,000 cubic yards pass from the Missouri into the Mississippi River every year. This represents a prism a mile square and 400 feet deep. This supplements the bar-growing material in

the stream below. It constitutes what is called the through transportation or the spoil of the Missouri basin. The balance of the material which may have been in transit is left within the valley, forming new banks and bars, and, in time of overflow, in building up the general valley. It is true that the general elevation of the valley is slowly rising.

One of the arguments advanced for the improvement of the Missouri River is that by a comprehensive improvement of it, say as far as Sioux City or on up to Carroll, the through transportation of sediment will be reduced, and that in so doing the bar-growing element in the Mississippi River will have been reduced, and therefore the difficulty of improving the Mississippi River will have been lessened.

Senator BOURNE. What is the total acreage that is each year eroded on the Missouri River?

Mr. FOX. It is about 10,490 acres in the 807 miles from its mouth to Sioux City.

Senator BOURNE. That is lost each year?

Mr. FOX. Yes; from the mouth to Sioux City.

Senator BURTON. That is very interesting to me, Mr. Fox; I was not aware that anything like an estimate claimed to be exact had been made on that. Did you make that yourself?

Mr. FOX. The statement previously given that the average annual erosion of the Missouri River is about 13 acres per mile of river was taken from a paper prepared by Mr. J. A. Ockerson and published by the American Society of Civil Engineers in their transactions for 1893, Volume XXVIII, pages 417-424. The author states: "The data for determining the amount of erosion on the Missouri River was derived from a comparison of the surveys of 1879 and 1890." The other figures which I previously gave as to the volume of the average annual erosion on the river from Sioux City to the mouth were based upon Mr. Ockerson's determination of the acreage in connection with my own estimate of the average height of banks in the same reach. This I took to be 40 feet instead of 36 feet as used by Mr. Ockerson, believing it to be more nearly correct.

As you know, during the early history of the work on Missouri River by the General Government much time and money were devoted to obtaining and analyzing data of the physics of its flow. The annual report of (then) Maj. (now retired Brig. Gen.) Charles R. Suter, for 1881, in which he diagnosed the ills of the river and prescribed treatment, was formulated upon that data. That report has been the basis of practically all the operations since then; the methods of carrying out the work were developed from that time very rapidly, as money was appropriated, until the devices became standardized in the present form of bank revetment and dike work.

Senator BOURNE. Does the river make any new land to compensate for this loss, the 10,000 acres annually?

Mr. FOX. Yes, sir.

Senator BOURNE. How much in the same stretch?

Mr. FOX. It would very nearly compensate.

Senator BOURNE. It compensates itself?

Mr. FOX. Yes, sir. You see, out of all this material which we are here referring to, namely, the material eroded from the banks between Sioux City and the mouth and the through transportation, there is only a small percentage of the former that goes out of the river; the balance of it is used to restore and maintain the existing conditions. But there is a deterioration of channel that, if it were not for other corrective conditions, would continue and the river would get wider and shallower.

Senator BOURNE. Is the new-made land tillable?

Mr. FOX. Not immediately.

Senator BOURNE. But it ultimately becomes productive?

Mr. FOX. Yes, sir; it ultimately becomes so. It is very rich and fertile.

Senator BOURNE. So in effect it compensates itself?

Mr. FOX. Yes, sir.

Senator BURTON. Does it do quite that? You say the acreage is the same, but there is more moved some years than others, and of course it is in entirely different places.

Mr. FOX. There is a lot of land that is made unavailable for cultivable purposes, but the percentage of that land remains practically the same.

Senator BURTON. What percentage do you say goes into the Mississippi River of the total erosion?

Mr. FOX. Four hundred and thirteen million cubic yards are estimated to go into the Mississippi River; there are 687,000,000 cubic yards precipitated into the Missouri River by erosion of its banks between Sioux City and the mouth.

Senator BURTON. Do you think the estimate as large as that, nearly five-eighths or so, that goes into the Mississippi River?

Mr. FOX. Yes, sir. The quantity that passes into the Mississippi happens to be nearly five-eighths of the quantity that is eroded from Sioux City to the mouth, but that should not be taken to mean that the latter is the only source of supply of the former.

Senator BURTON. About five-eighths that is eroded goes into the Mississippi River?

Mr. FOX. Yes, if qualified as just stated.

Senator PERKINS. These lands belong to private ownership?

Mr. FOX. Almost entirely, if you eliminate railroad right of way and some urban tracts owned by corporations.

Senator BOURNE. I do not see how it compensates itself, if

there are 600,000,000 cubic yards eroded away and 400,000,000 cubic yards go through to the mouth of the Mississippi River; if that is so, I do not see how you get your compensation.

Mr. Fox. On that statement of the situation, of course, there would not be full compensation, but you should bear in mind that there is a lot of material contributed by erosion in the river above Sioux City, and also from uplands. And in overflows enormous quantities of material are left upon the main banks as well as low-lying lands, thus contributing toward compensation. In further illustration of the compensating influences that are in constant operation, I might add: By far the greatest erosion occurs on the concave banks forming the bends in the river. This material does not travel far. Much of it is dropped in the first crossing below and under the point on the same side of the river at the foot of the bend. As the bank in the bend recedes the opposite shore advances in the form of a low-lying bar. The latter continue to advance until the point is reached where, by reason of the contraction of section, its face is swept by a current strong enough to carry away, as fast as contributed, the material brought in over its crest. At this juncture its farther advance is very sensitive to the recession of the opposite bank. As time progresses this bar is builded up by bed movement of material from above, until it gets above water. Then a growth of willows, by causing deposit from flow, carries on the process of upbuilding (provided it be not meanwhile carried away by channel shifting) to an elevation approaching the normal flood plane, where the willows are gradually replaced by growths of cottonwood.

Senator GALLINGER. And is not a good deal of this land that is eroded and carried into the stream worthless, so far as cultivation is concerned?

Mr. Fox. That portion of it that is from caving bends is good land.

Senator BURTON. While you are here there are two or three questions I would like to ask you.

Mr. Fox. Very well, sir.

Senator BURTON. In the most elaborate plan for the improvements between the mouth of the Missouri River and Kansas City, how many miles would have to be furnished with spur dikes?

Mr. Fox. If I were in charge of the river, I should limit that to a very small amount. I would use a minimum amount of spur-dike work.

Senator BURTON. About how many miles?

Mr. Fox. I do not know. If I could get along without any of it, I would do so. I should resort to longitudinal dike work rather than spur-dike work.

Senator BURTON. You believe in longitudinal dike work?

Mr. Fox. Yes, sir; in preference to spur dikes.

Senator BURTON. Has that plan been considered by the engineers?

Mr. Fox. Yes, sir.

Senator BURTON. And disapproved by them?

Mr. Fox. The longitudinal dikes? No. Their use has been approved.

Senator BURTON. About how many miles would you think—what would be your estimate?

Mr. Fox. Well, I have not gone into that recently to make a comparison, but the estimate is based upon the equivalent of revetting one bank all the way from Kansas City to the mouth.

Senator BURTON. Do you think that is necessary?

Mr. Fox. Three hundred and ninety-one miles. I think that or the equivalent of that would be necessary.

Senator BURTON. That is, longitudinal dikes?

Mr. Fox. Revetment.

Senator BURTON. On one side or the other?

Mr. Fox. Using longitudinal dikes where they are indicated and revetment work where it was indicated.

Senator BURTON. What do you say the distance is? One statement here is that it is 386 miles and another statement is that it is 392 miles.

Mr. Fox. It is 391 miles.

Senator BURTON. Major Schulz suggests two plans here, one costing less than four million and the other costing twenty million. What do you say as to those two plans? You have examined them, have you not?

Mr. Fox. The first one, costing three and a half million dollars, contemplates treatment that shall be largely confined to crossings in the river, and it was projected mainly with the view of getting a 6-foot channel way through those crossings, with only such additional work as was needed to make that river stable. I think Major Schulz at that time contemplated, in fact he says in his report, that such work should be followed up as quickly as possible with work extending above and below, so as to give a practically continuous treatment from Kansas City to the mouth.

Senator BURTON. What is your idea—that the expenditure of that amount of money would secure 6 feet?

Mr. Fox. What amount of money?

Senator BURTON. The three and a half millions or slightly in excess of that?

Mr. Fox. I think it would get 6 feet, but I do not believe it would secure it in the sense that it would be permanent, if nothing else were done.

Senator BURTON. It would get it in the first instance, but in order to maintain it it would require not only dredging but further treatment of the river; is that your idea?

Mr. FOX. I did not say dredging. It would require an extension of the work contemplated under the 6-foot project, so that in effect it would be continuous from Kansas City to the mouth.

The CHAIRMAN. Further deepening.

Mr. FOX. By fixation of the river both above and below and between those points.

Senator BURTON. Between what points?

Mr. FOX. Between those points that are contemplated to be treated under the 6-foot project.

Senator BURTON. Well, in order to maintain this depth from Kansas City down, would work be necessary above Kansas City?

Mr. FOX. I think not.

Senator BURTON. That stretch would take care of itself?

Mr. FOX. I think it would.

Senator BURTON. If elaborately treated?

Mr. FOX. Yes, sir; it is long enough to take care of itself. Conditions there would be helped however, if there were an extension of improvements from Kansas City upstream.

Senator BURTON. You have mentioned all that.

Senator STONE. I should like to ask a question, if it will not interrupt you.

Senator BURTON. Certainly.

Senator STONE. I would like to ask whether in your opinion dredging would be required on the Missouri River as a part of this scheme of improvement, and if so, to what an extent?

Mr. FOX. It would not be required under any comprehensive project for the systematic improvement of the river, but might be advantageously used to a limited extent in special cases to facilitate or hasten results.

Senator GALLINGER. You have spoken with much positiveness about certain parties raising \$1,000,000 to put a line of boats on the river. That, I assume, is contingent upon the improvement of the river by the General Government.

Mr. FOX. They are going to put a line of boats on without regard to what Congress does. There is no contingent item in it whatever. That \$1,000,000 will be raised and the boat line will be put upon the river independently of what is done here. Kansas City is in a position where it must be done.

Senator GALLINGER. Yes. Of course I ask for information.

Mr. FOX. Of course Kansas City is very anxious that Congress shall go ahead with the improvement of the river. That will facilitate their purpose in navigating the river enormously; but I desire to emphasize the statement previously made, that without regard to

what Congress shall do in the matter, Kansas City will put a line of boats on the river.

Senator BOURNE. The radius of operation of this proposed line of boats depends materially upon what aid the Federal Government gives, does it not; otherwise, I do not see the necessity of this improvement if they can already operate—I mean from their standpoint.

Mr. Fox. I thought I made myself clear on that point, in this way, that we have now a river which, as a result of late floods largely, affords a navigable depth in excess of what we may expect if the river is allowed to deteriorate, as it will if left to its devices, and when it gets down to the 3-foot basis, which I consider normal, between the mouth and Kansas City, the effectiveness of any line of boats on the river will be reduced very materially. Of course, to whatever extent Congress shall improve the river, the effectiveness of the boat line will be increased.

Senator STONE. How many months in the year would this boat line be able to operate boats?

Mr. Fox. About nine months, I think.

Senator STONE. In its present condition?

Mr. Fox. About nine months. The river during the winter is closed from December on through February.

Senator STONE. Are there not months when the river would be much lower than during other months?

Mr. Fox. Oh, yes. After the subsidence of the June rise the river continues to drop back to the lower stage, until along in the fall; then we have usually a small increase in stage due to fall rains. The river then declines until the usual winter stage is reached. Navigation is at its best for only about five months in a year.

Senator STONE. During those low stages would boats run?

Mr. Fox. Of course they can run, but under restrictions imposed by a necessary reduction in effective load draft on account of reduced available depths in the river.

Senator GALLINGER. Awhile ago I asked you a question that you did not answer, as to the probable type of boats that this company proposes to build. Is it a barge?

Mr. Fox. I think so; but as I have before stated, I am not authorized to say what type of boats will be adopted. If my advice were asked, I would recommend a unit consisting of a towboat and 16 barges, to be operated in this way: Each tow to consist of four barges, the other barges being left at terminals for loading and unloading, and in that way enable the power boats to be under way the major portion of the time. As an auxiliary to the towboat and barges, I would recommend the use of as many power carrier boats, or packets, as the development of the business indicated.

Senator PERKINS. What is the velocity of the current at this stage of the water, sir?

Mr. FOX. It varies, Senator. I should say from 2 miles an hour up to 7 or 8.

Senator BURTON. It then takes some considerable power to stem the current?

Mr. FOX. Yes. In times of flood it would be very difficult to make good progress in the face of the current, but the upstream boats can almost always find slack water during the flood stages. Of course the current facilitates travel downstream.

Senator GALLINGER. In view of the fact that German waterways carry their traffic in barges that convey from 600 to 1,000 tons on a waterway of $5\frac{1}{2}$ feet, is there really any apparent necessity for making this waterway deeper?

Mr. FOX. One of the features of the Missouri River that would be a controlling element in determining the units which would be most useful on the Missouri River is the sinuosity and form of its channel. The curvature of many of the bends is so sharp that in going downstream even packets have to flank them, and it is often necessary with tows to buckle as well as flank. For that reason the unit would be limited in size both as to length and width.

Senator GALLINGER. We have a provision in this bill which came from the House providing for an experimental line of boats on the Missouri River, and I understand the gentleman who is promoting that and believes in it says that probably they will not be of greater draft than 4 or 5 feet. I simply want to get the facts clearer in my own mind as to the necessity for a greater depth than 6 feet.

Senator STONE. Senator Gallinger asked you about the barges used in Germany. What are the distances the barges would travel on the Missouri River from Kansas City down as compared to the distances they travel in Germany?

Mr. FOX. I am not familiar with the German commercial problem. The Missouri is navigable for a much greater distance than any river in Germany is.

Senator STONE. Well, it would be much longer, as a rule, would it not?

Mr. FOX. The travel on the Missouri River would be 391 miles from Kansas City to the mouth and an additional 17 miles from the mouth to St. Louis. But I imagine that a condition will develop on the Missouri River in which there will be heavy local traffic from points between those two. As I understand it, the experience of the old boat line was that in going down the river they began to pick up east and south bound freight at a point somewhat east of Kansas City, and an increasing load of freight was taken on as they went downstream, so that the average haul on the downstream freight

was considerably less than the distance from Kansas City to St. Louis.

Senator BURTON. The barge navigation has been tried on the river, has it?

Mr. Fox. To a small extent by the Hermann Packet Company, at Hermann. Of course, there was also the transportation of construction material by the Government, involved in improvement operations, and that is just as good an illustration of the possibilities of navigation as though it were commodities of commerce.

Senator BURTON. Has there ever been a barge line from Kansas City to St. Louis?

Mr. Fox. Not that I know of.

Senator BURTON. Are you familiar with the kind of navigation, or have you read or heard of it, that was in effect back in 1858? I noticed in the railway guide that there was a railroad that had a few trains that carried passengers to Jefferson City, but from Jefferson City to Kansas City they were sent by boat. Do you know what type of boats they were?

Mr. Fox. They were the side-wheel boats.

Senator BURTON. How much did they draw?

Mr. Fox. I think about 3 feet.

The CHAIRMAN. Is there anything further that you want to elicit from this gentleman?

Senator STONE. Senator Bourne has suggested that you describe to the committee the kind of work you did on the river.

Mr. Fox. The revetment work on the river was the result of a good deal of experimentation by the Government, and, finally, resulted in what is known as the "continuous woven-willow type." It consisted of a mattress made of willows, woven in basket form into a continuous piece that was about 80 feet wide from the standard low-water contour of the bank and extended from end to end of the bank to be protected. This mattress was reinforced by a system of galvanized steel-wire strands and anchored to the bank by means of those wire strands to deadmen back of the top of the bank. The bank from standard low-water contour, or the inner edge of the mattress, as nearly as the stage of the water permitted, was graded to a slope that varied from two to three on one, or, even flatter in some localities, by means of an hydraulic jet. The mattress was sunk in contact with the bottom by means of riprap stone, and the upper bank, from the inner edge of the mattress to a contour about $2\frac{1}{2}$ feet above standard high-water plane, was protected by means of a pavement of riprap stone. This pavement was covered over with spawls that would fill the interstices of the pavement.

Senator MARTIN. How long do those mattresses last?

Mr. Fox. Indefinitely, if not outflanked by the river or torn by abrasion from ice.

Senator MARTIN. Would not they rot out or decay?

Mr. FOX. No, sir; because, in the later constructions, when the revetment became standardized to the specifications I have just given the inner edge was kept down near the standard low-water contour, and that provided for all but a very narrow strip of the mattress being constantly under water; and all of it was under water for a long enough period to thoroughly leach out those acids that tend to decay the brush, so that in a short time the brush forming the mattress was robbed of its rotting qualities and was indefinitely preserved.

Senator MARTIN. What length of time by actual experience have you observed those mattresses, and how long have they been constructed—what length of time for observation have you had?

Mr. FOX. Since 1879.

Senator MARTIN. About thirty years?

Mr. FOX. About thirty-one years; yes, sir.

Senator MARTIN. And there is no indication of decay or decomposition at all in those thirty-one years?

Mr. FOX. The standard construction of which I speak was not adopted until some time after that, but of the earlier structures which were put under water, we have a good many examples which prove that brush mattresses below a constantly wet horizon do not decay.

Senator MARTIN. Some of the parts are under water and some are not?

Mr. FOX. Those parts of mattresses that in the early constructions were well above midstage rotted out sooner or later; more quickly if the brush had been cut during the period of active growth than when cut late in the fall or winter.

Senator MARTIN. What was the result to the balance—did it not give way?

Mr. FOX. In the earliest constructions; yes. But later on the anchorage held the lower work in place, and the danger was confined to the upper bank work.

Senator MARTIN. Do you not have to renew the part of it that rots out for the protection of the part that is under water?

Mr. FOX. In the later construction, when revetment became standardized, the specifications were such that no part of the work was of a perishable character. It was all of a permanent character, with stone on the upper bank and brush on the subbank.

Senator MARTIN. So that as now constructed you would consider them imperishable?

Mr. FOX. I would consider it practically so; as much so as any work of man is.

Senator MARTIN. As much so as stone or iron?

Mr. FOX. It is made of stone where exposed.

Senator MARTIN. I thought it was made of brush.

Mr. Fox. The brush is under the water. And there it is not perishable. We have taken out of the river pieces of wood from hulls and trunks of trees that must have been there a great many years. I remember in excavating for a new mouth of the Osage River we found in the bottom of the cut which was below the line of permanent saturation black walnut trees over which there were growing white oak trees that must have been 600 years old. Those trees were in a perfect state of preservation; they were absolutely sound.

Senator MARTIN. And you are satisfied that the revetment as now constructed is practically imperishable?

Mr. Fox. So far as the deterioration from mere age is concerned. If you stop short of carrying these revetments to a point of permanency you are liable to lose them from an outflanking movement of the river; and there is where much of the percentage of maintenance shown in the reports comes from. As a matter of fact, at the time the Missouri River Commission was abolished in 1902, an examination was made of the work in First Reaches, and the deterioration of the revetment there was found to be less than 1 per cent, although the construction of those revetments began in 1891 and progressed along until 1896. The dike work, which is essentially of a temporary character, showed a deterioration of about 6 per cent.

Now, these works are of such a character, and the Missouri River of such a character, that the necessity for maintenance develops early in the life of them. It is in that period when they are exposed to the most violent attacks of the river. After they have been in—as they grow older, the river becomes used to their presence, or, has been trained by them so that they are not subjected under ordinary conditions to anything like the attacks that they are in their earlier stages, and it is before this time that the repairs should be most promptly and carefully made. I have seen thousands of dollars worth of work destroyed because we were unable to make repairs as the necessity for them developed. Oftentimes an expenditure of \$100 opportunely made would have saved work that cost thousands of dollars to build. If the repairs are kept up in the early life of the work, and more particularly in the case of the revetments, it becomes stabilized, so that it practically takes care of itself. The first flood is a very critical time for a revetment—probably the most critical time in its life. The flood searches out, as no inspector can, the weak points in the revetment and develops them. Then, after the subsidence, or during it, as may be necessary, if you are there promptly and will take the stitch in time, you not only save nine but possibly many multiples of nine.

The CHAIRMAN. Has not the committee heard enough about revetments to understand it?

Senator BOURNE. I would like to know the estimated cost of revetment work on the Mississippi River as compared with the Missouri River.

Mr. FOX. It is about 10 to 35.

Senator STONE. Did you construct that work there from Jefferson City down?

Mr. FOX. A large part of it. For some years prior to leaving the service I was in charge of the river from Sioux City to the mouth.

The witness was thereupon excused.

Senator STONE. There is just one more witness from Kansas City who would like to be heard for a few minutes. He is Mr. Wilson, who is the traffic commissioner for the Commerce Club of Kansas City, which is the dominating commercial body of that town.

The CHAIRMAN. The committee will hear Mr. Wilson.

STATEMENT OF H. G. WILSON.

The CHAIRMAN. What is your business?

Mr. WILSON. I am commissioner of the transportation bureau of the Commercial Club.

The CHAIRMAN. Located where?

Mr. WILSON. Kansas City. I have charge of the transportation and commercial interests of the different commercial interests of the city, and the Commercial Club has a membership of something over 3,500 individuals.

Senator STONE. How long have you been connected with that work?

Mr. WILSON. I have been connected with that work in Kansas City since June, 1906.

Senator STONE. What had you been doing previously?

Mr. WILSON. Prior to that time for ten years I was connected in an official capacity, with the freight traffic department of the Kansas City, Fort Scott and Memphis Railroad, and its successor, the St. Louis and San Francisco Railroad Company, and during that time, during the last four years of that period, I had charge exclusively of the foreign freight traffic—that is, the export and import traffic, and as such I became familiar with water-borne commerce, as well as with rail-carried commerce.

During the year 1908, in addition to my other duties as commissioner of the transportation bureau, I managed and operated the last steamboat line that was operated on the Missouri River between Kansas City and St. Louis.

I want to speak on this subject with reference to the commercial conditions, the commerce that might be carried on the river, if improved, and the commerce that would be affected in the way of

freight-rate adjustment by an effective waterway transportation on the Missouri River. To do this it is necessary to explain to you—and I will be as brief as possible—something of the influence on the traffic destined to points west of the Missouri River and originating in that territory, and the traffic produced at and originating in points east of the Mississippi River. One is the great bread-basket territory of the country; the other is the great consuming territory of these products, and the territory which produces largely the manufactured articles that are used in the West.

The city of Kansas City—and I shall mention that more, perhaps, than other cities—is in the same relation to that territory and the rate adjustments as other Missouri River cities from Omaha and Sioux City to Kansas City, and particularly what are termed in rate traffic parlance as the lower Missouri River, or southwestern Missouri River points, the cities of Kansas City, Atchison, Leavenworth, and St. Joseph. The communities at the southwestern Missouri River point are not manufacturing centers, and to an extent they are jobbing centers. They assemble in large quantities the goods that are produced at points on and east of the Mississippi River and north of the Ohio River, and distribute in smaller quantities to territories west, northwest, and southwest of the Missouri River, and particularly of Kansas City.

The freight rates from the territory known as "seaboard" territory, the trunk-line territory, which is that part of the eastern territory I have described, lying east of Pittsburg and Buffalo, to the Missouri River points are made on a combination of locals through the Mississippi River, locals from seaboard territory to St. Louis, if you please, and local from St. Louis to Kansas City. But the rates to points immediately west thereof are all made by still adding the additional local from Kansas City to points west, like Salina, Kans., and Denver, Colo. That is true to points northwest to a degree except that out in the Dakotas and in the extreme northwest the rates from the seaboard territory are made on combinations through St. Paul, the rates through St. Paul being less than the rates through Kansas City as a result of the fact that the rates from seaboard territory to St. Paul are less than the rates from seaboard territory to Kansas City, a result of water influence, the Soo Canal, and the Duluth gateway. The rates to southern Kansas points and northern Oklahoma from seaboard territory are made on the St. Louis combination, but the rate from St. Louis to southern Kansas and Oklahoma is not the Kansas City combination, but a percentage of it—less than 100 per cent of the two rates in each case. To illustrate: The rate from St. Louis to Kansas City on first-class articles is 60 cents, and from Kansas City to Wichita the first-class rate is 66 cents, a combination of \$1.32, yet the rate from St. Louis to Wichita is \$1.19½.

Senator BURTON. One dollar and twenty-six cents.

Mr. WILSON. I should say \$1.26.

In other words, the St. Louis-Wichita rate is 95 per cent of the St. Louis-Kansas City-Wichita combination. The rates to Texas points—I should say first that with the rate from St. Louis to all this territory fixed, the rates from Chicago are fixed on a differential basis higher than the rates from St. Louis.

Now, the rates from seaboard territory to Texas points are made 25 cents first class higher than the rates from Chicago to Texas points, using the combination of local rates from seaboard to Texas points as a maximum. So that you will see that the rate from the Mississippi River to the Missouri River, or between the two rivers, is the pivotal factor on which all of the rates of freight from all of the territory east of the Mississippi and north of the Ohio practically to all territory west of the Missouri and southwest of the Missouri, including the inter-mountain country, but not including the Pacific coast country, is based. The rates are either based on the rate between the Mississippi and the Missouri rivers, or the rates are made with some relation thereto. So that any change made in the rates across the State of Missouri would have its influence on the general adjustment of rates to and from the territories both east of the Mississippi and west of the Missouri. And what I say with reference to this adjustment westbound applies in general with respect to the rates from the West to the East, except that the conditions—traffic I should say—are most sensitive as to rate adjustment or differences in rates. You will all understand that the raw material, the product of the farm or the field, is more susceptible to the influence of a freight rate, and where a slight change in the rate on dry goods would not affect dry goods, a very fractional change on the rate on grain would affect grain, its values, the destinations to which it could be sent, the values which the producer would receive.

So, without undertaking to elaborate any more on that rate situation, you will see the influence of the rates between the Mississippi and the Missouri rivers.

Now, the purpose of Kansas City, particularly interesting itself in the establishment of a boat line, is brought about by a combination of conditions, the result of the accumulation of troubles of several years' standing. The rates to the southwest of us are so much less and grow so much less as a through rate than the combinations through Kansas City, that it is becoming, it is fast becoming, an impossibility for our jobbers to assemble these goods and retain the trade in the southwestern territories, which they have heretofore had and on which largely Kansas City lives. We live on the territory immediately west and southwest of us, taking a radius from Denver and circling down as far as to the Texas gulf coast. Now then,

if the merchants in that territory are enabled to get their goods from the producer at a less freight cost than we can assemble those goods and deliver them, we have to do one of two things—either absorb the difference in the freight cost, or retire from that business. In some lines of goods we can make the absorption; in other lines of goods we have to retire, and our merchants have retired from that business largely in this way, that, not being satisfied to lose that business, they have established, by force of necessity, branch distributing houses. One grocery house in our city, particularly, maintains fourteen branch houses throughout the Southwest. Two of those branch houses do a larger amount of business than the parent house at Kansas City. That same condition is true of other grocery jobbers; it is true of hardware jobbers, and it is true in the case of one boot and shoe house, and it is true in the case of two of our dry goods interests. Viewing this pinnacle of high freight rates, the Kansas City merchant feels that it is necessary to reinstate or revive the competition, there being no effective competition between rail carriers, which has heretofore assured low or reasonable freights. Therefore they are organizing this boat line with the idea of establishing this competition, carrying an amount of tonnage that will benefit them on a profitable basis, and establishing a competition which is wanting and which they hope will have its influence on the rail lines by inducing them to reduce their freight cost.

Senator GALLINGER. How do your freight rates compare with, say, five or ten years ago? They are much less, are they not?

Mr. WILSON. Our freight rates to-day are 40 per cent higher than they were prior to January, 1906.

Senator GALLINGER. Forty per cent higher?

Mr. WILSON. Yes; they are 40 per cent higher. I am speaking, Senator, of the freight rate actually paid by the merchant, and not the paper rate, which is the same to-day as it was at that period.

Senator BURTON. What explains the difference?

Mr. WILSON. The effective administration of the interstate commerce act.

Senator BURTON. That is, there are no more freight rebates.

Mr. WILSON. There are no freight rebates; no, sir. Rebates were paid by the railroads and accepted by the merchants. Why? To equalize these maladjustments of freight rates.

Senator NELSON. Hasn't there been some increase through a change of the classification of freight?

Mr. WILSON. There is always a change going on in the classification.

Senator NELSON. That increases the rate?

Mr. WILSON. Unfortunately, yes; the classification changes which have been made since August, 1906, have generally been in

the nature of advances. A very large number of articles which were previously provided with what we term commodity rates—special rates taking them out of the classification—have been restored to the classification and to the classification to which they previously belonged, and that resulted in an advance of the rate.

Senator GALLINGER. I asked the question for the reason that it is generally understood in our part of the country—in the East—that freight rates have been very generally reduced of late years, and I am astounded to learn you are suffering under a burden such as you have mentioned.

Senator BURTON. The rate as published would not have resulted in any such difference?

Mr. WILSON. Practically none, so far as class rates are concerned. The rates as published on commodities now and as applied on commodities fifteen years ago would show a considerable advance on a large percentage of those commodities.

Senator BURTON. That is due to the difference in the classification?

Mr. WILSON. That is due to the fact—

Senator NELSON. What do you understand by commodity rates?

Mr. WILSON. A commodity rate—

Senator NELSON. By commodity goods, I mean?

Mr. WILSON. There is no fixed rule. Any article may at any time be taken out of the classification and provided with a commodity rate. There is no prohibition.

Senator NELSON. Do you call a rate on coal, or lumber, or grain a commodity rate?

Mr. WILSON. Yes, sir. Those articles are among the articles which are almost invariably provided with commodity rates. As an illustration: In our western classification lumber, coal, and grain, in carload quantities, are not provided with ratings in the classification. They are mentioned, but they always refer to the commodity tariffs. That is not true in the Central Freight and Trunk Line Association tariffs, because they have a larger number of classes and they provide class rates for those articles in addition to applying the commodity.

Senator NELSON. That is true between the seaboard and the Mississippi River?

Mr. WILSON. Yes, sir; that is true between the seaboard and the Mississippi River.

Senator SIMMONS. Did you say this increase in the rate was the result of the abolishing of rebates?

Mr. WILSON. In effect, yes, sir; I said it was as a result of the effective administration of the interstate-commerce act.

Senator SIMMONS. Everybody was not enjoying these rebates.

Mr. WILSON. No, sir.

Senator SIMMONS. Now, what would be the effect in the actual amount of freight paid to the man who was not getting the rebate?

Mr. WILSON. He is probably paying either the same or a greater rate in the western country; west of the Mississippi River.

Senator SIMMONS. Why is he paying a greater rate if he did not get any benefit from the rebates before?

Mr. WILSON. If he was a merchant who shipped an article provided with a commodity rate which has subsequently been restored to the classification, he is paying now the classification rates instead of the lower commodity rate.

Senator SIMMONS. And the increase, as to him, has been the result of the classification?

Mr. WILSON. As to him in that case largely.

Senator NELSON. Then there has been another change. In addition to the changing their commodity to classification rates they have also increased rates by changing goods from a low classification to a higher classification. There has been a good deal of that, hasn't there?

Mr. WILSON. Yes, sir; there has been a good deal of that. As an illustration, at the meeting of the western classification committee, in Charlevoix, Mich., in July, there were applications for some 543 changes in the ratings, classification. Perhaps 500 of them were applications for reductions. There were three definite actions taken by the classification committee.

Senator NELSON. What were they?

Mr. WILSON. And each one of those three were advances in rates, by taking commodities out of commodity lists and restoring them to classified.

The CHAIRMAN. Well, now, what about the Missouri River? How is that going to help you out? What do you want done about that?

Mr. WILSON. As far as the commercial situation is concerned, a transportation line operated on the Missouri River, a water carrier being effective, having sufficient capacity to carry—and in fact carrying—a sufficient quantity of tonnage to make that tonnage noticeable to the rail carriers, will exert an influence on the rates of the rail lines, forcing them to meet the competition so established, which will result in a lowering of the freight rates, not only to and from Kansas City and the other southwestern Missouri River points, but to and from all of the trade territory in the Southwest—Kansas, Oklahoma, Texas, Denver, Colo., New Mexico, Arizona, and Nebraska. All of this territory, all of these States, will be benefited by a reduction in the freight rates.

Senator PERKINS. Is it not a fact that the railroad companies generally agree with the steamboat companies on the rivers and allow them a certain differential? That they agree upon a traffic ar-

rangement, so that the producer and consumer will derive no material benefit from it?

Mr. WILSON. That is true, I think, where the water lines are not controlled individually; where they are railroad controlled. By individually I mean investments in water transportation lines by individuals who have no other interest except that of transportation, whose purpose it is to keep the rates up in order to get the maximum of revenue by their line, which is also the aim of the rail line.

Senator BURTON. This proposed company is to have the capital furnished by shippers, the shippers to agree to ship their freight by that line and not divert it to the railways?

Mr. WILSON. Yes, sir. The organization of this company contemplates the subscription of stock by the shippers, the merchants and manufacturers of Kansas City, as well as the citizens. Its incorporation is so protected by its directors and stock ownership that control can not be lost from the Kansas City interest. It can not be controlled by any outside interest.

Senator PERKINS. But they can only transport a small percentage of the products of the country tributary to their line?

Mr. WILSON. It would be a small percentage of all the products of the country; yes, sir. But as to the products of the West and Southwest, we feel that we will be able to transport at least 10 per cent of the volume of traffic moved from the Mississippi River to the Missouri River, and in the reverse direction, that is destined west and southwest of the Missouri River, and also originates in that territory and has destination at points—

Senator BURTON. You assume then that the railroad company would carry the other 90 per cent at the same rate as transportation by the river?

Mr. WILSON. No; I do not. I never expect to see the day when the rail lines will make the same rates via the rail lines as will be made via the boat lines, even though the percentage of tonnage carried by the boat lines should reach 25 or a greater percentage of the total. But there is this about it—I would like to say, if you please—there is a percentage, and it is susceptible to determination, that influences—although it may be a small percentage—that influences the rate adjustment on 100 per cent of the traffic. I believe that with the actual carrying of 10 per cent of the tonnage to and from Kansas City or to and from the Missouri River, destined to and from the territory southwest that I speak of, that an influence can and will be exerted on 100 per cent of the traffic carried into that territory, whether that traffic moves via boats to Kansas City or from Kansas City, or whether it moves via rail and water, or moves via the Missouri River at all. In other words, there are now approximately 5,000,000 tons of traffic originating at points in the

central freight association and trunk-line territory finding destination at Missouri River points, and at points in the Southwest, a large proportion of which actually moves through the Mississippi River and the Missouri River. There is a part of that tonnage which reaches its destination without touching the Missouri River. For instance, traffic to Oklahoma, southern Kansas points, and to Texas points, moving from St. Louis, having originated in the East, via the direct lines, via the Frisco, the M. K. T., the Cotton Belt, the Iron Mountain, and such lines. There is another large volume of traffic moving from the trunk line territory via water lines and the Virginia ports, thence via the rail lines to the Mississippi River, and thence direct lines to the Southwest, or through Memphis or Atlanta or Shreveport, also through Alexandria and Texarcana; also by the Atlantic steamship lines around by New Orleans and Galveston and north via the rail lines, and none of which actually moves from the Mississippi River, but all of which is affected by the rate adjustment between the Missouri and the Mississippi rivers.

Senator BURTON. So, as a question of transportation contemplated, you believe it would be profitable to take any freight from an eastern point bound to a western point beyond Kansas City, removing it from the train at East St. Louis, carrying it on around Kansas City, and then loading it onto another train?

Mr. WILSON. I understand.

Senator BURTON. They are not independent, but artificial freight rates—would that be profitable?

Mr. WILSON. I understand. Speaking of certain classes of traffic, I would answer yes to that question, and, Senator—

Senator BURTON. What classes?

Mr. WILSON. And that would be on the high-class traffic.

Senator BURTON. Now, suppose you were shipping from New York to Washington by rail. Would it be worth while to take the freight off at Wilmington, ship it to Philadelphia, and then put in on the train again?

Mr. WILSON. I would say no.

Senator BURTON. Do you know of any instance in the country where for a comparatively short trip like this it is taken off the boat and put on the train again?

Mr. WILSON. No, sir; I would say I do not, except under artificial conditions and arbitrary conditions.

Senator BURTON. Really, what you are aiming at is to gain a reduction in freight rates by railroad, with the thought that the freight will still go by rail.

Mr. WILSON. No, Senator, I want to make it clear just exactly what we are trying to do. I am very closely allied with this company. Questions were asked Mr. Fox this morning that he did not feel that he had a right to answer. I have no hesitancy in saying

what we hope to do about this. There is no secret about it, although we haven't made much talk on this subject previously. Our intentions with respect to the new water-transportation line on the Missouri River are not to confine its operations between St. Louis and Kansas City. We realize, as well as anyone can and as clearly as anyone can, the absurdity of short-hauling this transportation, this traffic that originates at so much greater distances. There would not be a sufficient saving either in the time or in the freight cost to justify doing that. Our purpose is to branch out as rapidly as we can, to extend the operations of this line between Kansas City and New Orleans, between Kansas City and Cincinnati and Pittsburg, between Kansas City and up the Illinois River at least as far as Peoria, and on the upper regions of the Mississippi River as far as that is possible. However, at the inception of this movement we probably will do what we did at the inception of the boat line which I did handle. The short haul on that traffic was the rail haul, although the traffic originated at seaboard territory and in the trunk-line territory; it was water-borne transportation, by rail from Chicago to East St. Louis, and then by water from East St. Louis to Kansas City. So it was the railroads that were short-hauled in that traffic, and the saving was considerable in that in the first cost. That little line made a basis of rates of 66 $\frac{2}{3}$ per cent of the rail rates westbound. Their eastbound rates were not on that basis, because it was an entirely different class of traffic, and they did not expect to and did not get very much of it.

Senator BURTON. Of course there is this argument in that connection: From St. Louis to New Orleans that traffic has fallen off so as to amount to practically nothing.

Mr. WILSON. But the influence is there on the rate, Senator—

Senator BURTON. Let me just state my question. Eight feet farther down? Now, what ground is there for expectation that, if the traffic does not develop from St. Louis to New Orleans with 8 feet part of the way and 9 feet the rest, the traffic would develop from Kansas City down? That is 400 miles and more beyond St. Louis, with only 6 feet.

Mr. WILSON. Well, I don't want to be misinterpreted as making a short answer, but my answer would be that that is St. Louis's business. We feel that there is this necessity for finding some means to transport water freight at less freight cost than we are now encountering. We will use the Mississippi River. We would be delighted to have 8 feet right now between Kansas City and Cairo. We are going to start this line, not believing that the equipment we will put on at the present time will be that which we will have ultimately in the end of an improvement period on the Missouri River, but it will serve its purpose while the river is being improved. In

other words, we have come to the point where we are waiting for the Federal Government to improve this river.

Senator BURTON. You are placed at great disadvantage in this territory tributary to the west and southwest because of the more favorable rates?

Mr. WILSON. And we want to make this point very clear to you. That while this boat line will benefit Kansas City and the southwestern Missouri River points to which it will ply, its effect—its beneficial effect—will also be felt very greatly by the communities to the south and west of us, whose rates will be affected presumably in the same degree as ours.

Senator BURTON. To what extent is Kansas City a point for the rehandling of grain?

Mr. WILSON. Kansas City is a second primary grain market of the United States.

Senator BURTON. And what is the first?

Mr. WILSON. Chicago.

Senator NELSON. Oh, no, not Chicago.

Mr. WILSON. I beg your pardon, Senator. No; I suppose Minneapolis and St. Paul?

Senator NELSON. Minneapolis and St. Paul.

Mr. WILSON. As a primary grain market.

Senator BURTON. And as regards the amount unloaded from cars there and placed in elevators, how much?

Mr. WILSON. We have an elevator capacity of 10,000,000 bushels at Kansas City. We ship approximately 50,000,000 bushels of grain annually. We receive considerable in excess of that because we have quite a large flour production. We were until last year, when Buffalo went ahead of us, the second milling center, the second flour milling center.

Senator NELSON. You must have been third. Minneapolis is the biggest milling center.

Mr. WILSON. I admit that Minneapolis is the biggest milling center. Kansas City was second until Buffalo came in last year, and Kansas City is now third, unfortunately, but we have a production; that is, we have a milling capacity of 12,500 bushels a day.

Senator BURTON. How much grain is shipped from elevators in Kansas City a year?

Mr. WILSON. About 50,000,000 bushels.

Senator BURTON. Where does that go mostly? To Galveston?

Mr. WILSON. It goes very largely for export. It finds its way out through all of the ports; through Galveston, through New Orleans, and all the Atlantic seaboard points.

Senator BURTON. What is the comparative rate from Galveston and New Orleans?

Mr. WILSON. They are the same, 18½ cents on wheat and

17½ cents on corn. They average about 4½ cents less than the rates to Atlantic seaboard points. That is an average to all points.

Senator NELSON. That is a great disproportion between wheat and corn, it seems to me.

Mr. WILSON. One cent; 18½ on wheat and 17½ on corn. There is just a cent difference on all that western country, on all traffic, on wheat and corn, except that moving to the Texas points. There is 3 cents difference there. The wheat rates also apply on flour out in that territory, and the corn rates on other coarse grain and mill feed and other products of that kind.

The CHAIRMAN. Is there anything further from this witness?

Senator STONE. I want to ask you one question about the little line, consisting, I think, of two boats that the Kansas City people put on two or three years ago.

Mr. WILSON. That was the Kansas City Transportation and Steamship Company. It was organized in the fall of 1906. At that time they chartered one small steamer and barge, the *Lora*, and made a sort of demonstration trip, loaded, from St. Louis to Kansas City, to demonstrate the fact that the Missouri River was a navigable stream. That resulted during that winter and the following spring in the purchase of two boats, the steamers *Chester* and *Tennessee*. They were operated during the seasons of 1907 and 1908. During 1908 I operated them myself. I should say the company was composed of the merchants of Kansas City. It was a company of small capitalization, only \$200,000, and only about \$175,000 of that paid. These merchants, of course, controlled the traffic. They routed a percentage of their traffic via East St. Louis, where it was delivered to the boat line and transported to Kansas City at these rates I have spoken of, two-thirds of the rail rates, and handling as much of it as they could. All that they could not handle, which they did not have the capacity to handle, was diverted again to the rail lines. During 1907 there were 20 tons of freight diverted to 1 ton handled westbound. In 1908 the same methods were pursued—

Senator STONE. Diverted by your company?

Mr. WILSON. Diverted by our company to the rail lines.

Senator STONE. It had been routed to your company?

Mr. WILSON. It had been routed to our company, but we did not have the capacity to handle it. These two boats were of small tonnage capacity. The *Chester* had a gross registered tonnage of about 468 tons and an actual physical carrying capacity of not to exceed 300 tons. The *Tennessee* was slightly less in tonnage and actual carrying capacity than that.

So these merchants, not being stevedores, not knowing how to stow freight, had routed too much of their freight that way, and they had to divert it to rail lines, and the diversion, I think, was about 20 tons via rail lines to 1 ton handled by boat. In 1908 a lit-

the more careful selection of traffic was made, and we felt that we would have been able to handle it, but we were interrupted by unusual weather conditions, floods and the like, which prevented our handling a good deal of it, and we diverted that year only about 10 tons by rail to 1 ton handled by boats. The operations were slow and expensive, due to the fact that the river was not provided with lights. The river had been so long neglected that pilots had largely lost track of it, and it was necessary to feel and learn the channels again. It was necessary to lay the boats up at night, so that the maximum we could ever get out of operations, even under the most favorable circumstances, was about sixteen to eighteen hours a day out of the twenty-four. We operated until September, 1908, when we lost one steamer by sinking. She struck a submerged snag in full load and sunk in about 9 feet of water. The water was very low. The other boat was laid up at St. Louis, and she has been laid up there since.

Senator STONE. Did you have any trouble with the insurance?

Mr. WILSON. We had no insurance. Marine insurance is unobtainable on the Missouri River at this time; has been for a long time. In operation of the new line which we are now organizing we figure on being able to operate our boats only about six months during the year, that being about all we can depend on for a sufficient depth of water. We want the river improved so that we can depend on a navigable depth during all of the open season.

The CHAIRMAN. Is there anything further from this witness?

The witness was thereupon excused.

The CHAIRMAN. Senator Stone, is there anyone else you would like to call on the improvement of the Missouri River?

Senator STONE. No; I think not.

The CHAIRMAN. Senator Warner, do you want to be heard on it?

Senator WARNER. Not at present.

The CHAIRMAN. Senator Lorimer, do you want to be heard? Is Senator Lorimer here?

Senator LORIMER. I am here.

The CHAIRMAN. Senator Lorimer, do you and Senator Cul-lum wish to be heard on the Chicago matter now?

Senator LORIMER. How much time will there be, Senator?

The CHAIRMAN. I want to keep the committee here as long as I can, because we will be disturbed this afternoon probably on account of the postal savings-bank bill.

Senator BURTON. I thought that did not come up until to-morrow, Senator.

The CHAIRMAN. It is only quarter past 12. I want to close up some of these matters if possible.

It seems to me, about the Missouri River and the Mississippi River, we ought by this time to have received all the knowledge that is obtainable.

Senator STONE. What is the suggestion of the chair?

The CHAIRMAN. That we close up any discussion about the Chicago matter.

Senator STONE. You mean before adjournment?

The CHAIRMAN. Yes; before adjournment.

Senator STONE. It is about half past 12 now.

The CHAIRMAN. Well, then, suppose we adjourn to meet at half past 1, and then dispose of all the discussion about the Chicago matter.

Senator LORIMER. I will be here at half past 1, then, Senator.

The CHAIRMAN. And will you have Senator Cullum?

Senator LORIMER. Yes; I will have Senator Cullom here at that time.

The CHAIRMAN. Then the committee will take a recess until half past 1.

(At 12 o'clock and 30 minutes p. m. the committee took a recess until 1.30 p. m.)

APPENDIX E.

STATEMENT OF GENERAL CYRUS B. COMSTOCK.

[Hearings before the Committee on Commerce, United States Senate, in relation to the improvement of the Mississippi River, May 12, 1890.]

General CYRUS B. COMSTOCK, president of the Mississippi River Commission, appeared before the committee.

The CHAIRMAN. Are you the chairman of the Mississippi River Commission?

General COMSTOCK. Yes, sir.

The CHAIRMAN. How long have you been connected with the Mississippi River Commission?

General COMSTOCK. Since its organization, in 1879.

The CHAIRMAN. Have you ever given personal attention to the work?

General COMSTOCK. Prior to that I was a member of the board on the improvement of the Mississippi River, which reported on the improvement of the river prior to the organization of the Mississippi River Commission.

The CHAIRMAN. Are you familiar with the Lake Borgne outlet improvement?

General COMSTOCK. In some degree.

Senator GIBSON. I suggest that General Comstock make a statement of the plan that the Commission has adopted, the work done, and the results achieved.

The CHAIRMAN. I want to ask one or two more preliminary questions, and then I will start him off.

Have you examined with any attention the recent inundations of the Mississippi?

General COMSTOCK. So far as the data has been worked up I have.

The CHAIRMAN. The committee is desirous of getting, so that all money that Congress may appropriate for the Mississippi River shall not be wasted, as much information as you are able to give them in relation to the Mississippi River, its improvements, the method of improvements, etc., of course including the proposed outlet at Lake Borgne; and if you will go on and make your statement in your own way it will be agreeable to the committee.

General COMSTOCK. The Mississippi River has widths of a mile and a half and possibly two miles in some places. In the worst

places the Commission has begun narrowing the river, or attempting to do so, down to a width of 3,500 feet in expectation of improving the low-water channel. They have tried it at one place, Plum Point. They have built, where they attempted to narrow the river, dikes out into the river and have put brush-work aprons on those dikes to keep the water from flowing through and make the water still, or partially still, behind them.

That is to produce contraction. Contraction has been produced and large deposits have been obtained behind the dikes built in that way. Under contraction on one side of the river, the river may cave very rapidly, and it may be necessary to protect the opposite bank to keep the river from running away from you. Where there is a caving bend you want to hold that bend in order to prevent the river changing its form and carrying away the other works. These caving banks are held by putting on them brush aprons and covering them with stone. That is the general method the Commission has used.

At Plum Point the water sometimes before the work began went down to $4\frac{1}{2}$ or 5 feet. In the last six or eight years the lowest it has been has been about $8\frac{1}{2}$ feet, and a very decided improvement in the river has been made.

The CHAIRMAN. What is the length of that?

General COMSTOCK. Thirty-four miles. The work of the Commission has been confined to some 15 or 16 miles.

The CHAIRMAN. There the result has been satisfactory to the Commission?

General COMSTOCK. Yes, sir.

At the Lake Providence reach, 60 or 70 miles above Vicksburg, the same method was undertaken; pile dikes were built in that way and enormous deposits were obtained. There was revetment of banks at certain places, especially at Pilcher's Point, Louisiana Bend. Those revetments became damaged. The appropriation for them for one year was not made, and in the following year Congress prohibited us from building revetments. The consequence was that we lost that work, something like 2 miles of it. That also interfered with our doing anything below; that is, the absence of money in the first year and the prohibition the second year, covering a period of three years altogether.

The same thing affected us down at the tow-head below at Myersville, and there also we lost a mile and a half or two miles of revetment.

The dike work has essentially produced the results it was built to obtain. So far for works in the bed of the river.

The Commission has also expected to improve the river by building levees on its bank. It has spent in building those levees something like three millions.

Those two methods combine the work done by the Commission. In reference to the outlet question, I made a report some time ago on the specific outlet proposition of Captain Cowden at Lake Borgne, and I do not know that I can do better than to read it.

Senator GIBSON. I did not understand you to say, General, what the results achieved at Lake Providence were, whether the channel responded, what the behavior of the river was, after you completed or partially completed your work.

General COMSTOCK. The channel has been better there since the work has been carried on so far as it has been done.

Senator GIBSON. How much have you spent on the levees?

General COMSTOCK. Something over \$3,000,000.

Senator GIBSON. What proportion of the levees erected by you has given way in this flood?

General COMSTOCK. I am not able to answer that.

Senator GIBSON. Some of your subordinates can, probably.

General COMSTOCK. Yes, sir.

Senator WASHBURN. What depth of channel was there before you commenced?

General COMSTOCK. Five or 6 feet; 5 feet probably.

Senator WASHBURN. And you have nearly doubled it?

General COMSTOCK. We have increased it about one-half.

In regard to the Lake Borgne outlet I would say, a canal a mile in width leading from the Mississippi into Lake Borgne, its bottom being everywhere 10 feet below low water, as proposed by the bill, would, by an approximate computation, which is the only one practicable in such a case, divert from the Mississippi about 400,000 cubic feet per second, when the stage of the river near Lake Borgne is about 7 feet above Gulf level, and 500,000 cubic feet when the stage there is about 9 feet. The corresponding stages at Carrollton would be about 10 and 12 feet (since the slope would at last be the present high-water slope), the maximum stage there being 15.6 above mean Gulf. An outlet diverting 400,000 cubic feet per second would lower the highest flood at Carrollton by about 6 feet.

These computations are based on the discharge curve at Carrollton of 1883. If more water is forced past Carrollton hereafter by maintaining levees above, these figures will need modification. Judging from the effect of local changes of flood height elsewhere on the river, this lowering of flood height at Carrollton would die out in something like 200 miles in ascending the river. Since for this distance the slopes would be steepened, it follows that velocities would be increased, with their destructive effects on the banks of the river and on levees. The outlet would do no good to navigation, but rather the reverse. The first effect of taking 400,000 cubic feet per second out of the Mississippi would be a large lowering of the flood surface near the outlet. The flow through Lake Borgne

would itself be a river of large size. Both theory and experience show that when, at all stages, a reduction in the size of a river flowing in alluvial soil is made, or the river is split in two, the smaller rivers gradually take greater slopes than the main river had. Hence both the main river and the new river would gradually increase their slopes to suit the new conditions. Since the slope begins at the Gulf, it can not become greater on the main stream below Lake Borgne, which is now nearly straight, without increasing flood heights at Lake Borgne. After some years, then, if both routes to the sea remain large rivers, the flood level above the outlet would be higher than it is now unless (as indeed is not improbable) the large amount of sediment which would be dropped into Lake Borgne (where the flood velocities would at first be but one-sixth of those in the Mississippi) should close this outlet, thus repairing the injury done to the main river. A large diversion of flow from the Mississippi to Lake Borgne would also seriously diminish the depth at the present mouths of the river.

For the following reasons, then, no important outlet at Lake Borgne should be either undertaken or permitted.

(1) It would for some years lower the floods at the outlet, accelerate velocities above it and increase caving and the consequent destruction of levees.

(2) It would cause shoaling at the present mouths of the river.

(3) If both the new outlet and the main river below it remained important streams—that is, if neither of them closed itself under the action of natural causes—the flood heights at Lake Borgne and New Orleans would after some years be greater than they are now.

It may be noted that if the United States desired such an outlet, its construction should be open to public competition instead of being a monopoly.

That relates only to forming an outlet which shall be a permanent stream. I think the water can be spared from the Mississippi River without injury to navigation under certain circumstances.

The CHAIRMAN. Do you think that would be desirable?

General COMSTOCK. I think that is desirable. At the Atchafalaya I think it is desirable to take five hundred or six hundred thousand cubic feet per second out of the river. In the same connection I have some memorandum as to outlets other than this outlet, if you wish to hear it.

The CHAIRMAN. Yes, sir.

Senator WASHBURN. Before you proceed let me ask you what would be the effect immediately on the main stream if you were to make a low-water outlet?

General COMSTOCK. I think it would shoal up immediately below, but not enough to injure navigation.

Senator WASHBURN. Taking as much water out as you say you would, it would shoal at the jetties?

General COMSTOCK. Yes, sir; and for 10 miles above there.

Senator WASHBURN. And still be an enormous amount of water?

General COMSTOCK. Yes, sir; still about one-half or two-thirds of the river, unless in making this outlet the whole river saw fit to go this way [indicating], which I do not think is probable. It will do no good to navigation and it would be of doubtful ultimate benefit to the levees.

Senator WASHBURN. What has been the ultimate effect of opening Bonnet Carré?

General COMSTOCK. Its effect in what way?

Senator WASHBURN. Below where it discharges; leads from the Mississippi into Lake Pontchartrain. Is that still open?

General COMSTOCK. It has been closed several years.

Senator WASHBURN. What was the effect when it was open?

General COMSTOCK. I think probably it shoaled the river somewhat below, but not enough to interfere with navigation.

Outlets have often been proposed as a method of reducing flood heights on the Mississippi. The immediate results of flood heights are so evident and so beneficial when a large crevasse is formed, the good results of an opening far larger than ever occurs naturally, seem so immediate and apparent, that it is not strange that many persons look on them as the true remedy for great floods.

In a letter of February 1, 1890, to the Chief of Engineers, I considered the effects of making an outlet a mile wide and to a depth of 10 feet below low water from the Mississippi River into Lake Borgne, and need not repeat the discussion here. In it I assumed what is well known to all persons familiar with hydraulics, namely, that a sedimentary river flowing in its own alluvion only acquires a stable regimen, when it has taken a slope suitable to its varying discharges and to the material through which it flows; and as a rule that these slopes diminish as the size of the river increases and increase as the size of the river decreases. It may be well to give some examples of this general fact.

The South Pass carried in 1875 about one-fourth of the water that the Southwest Pass did. Its slope from the Head of the Passes to its original bar was about one-third greater than that of the Southwest Pass.

The observed discharges of the Atchafalaya in 1882 were from one-seventh to one-tenth of those of the Mississippi. Its average slope to the Gulf is double that of the Mississippi.

The Sulina Pass in the delta of the Danube carries two twenty-sevenths of the total river flow, while the St. George Pass carries

eight twenty-sevenths. The slope of the Sulina is one-half greater than that of the St. George Pass.

These examples are sufficient to illustrate the general rule already stated, that sedimentary rivers flowing in their own alluvion take larger slopes the smaller they are. Hence, if at Lake Borgne or elsewhere in its Delta the Mississippi were divided into two rivers, since each would be smaller than the present river, the two new rivers would go to work to obtain the new and steeper slopes suited to dimensions smaller than those of the original river, and hence would build up their beds. This process would only cease when the steeper slopes needed by each were obtained. Since both rivers would then have one end at the Gulf, and have steeper slopes up to their point of divergence than the main river now has, the flood surface of the rivers at that point would be higher than now.

There have been cases where the experiment of dividing a river in two has been tried by nature or by man. About A. D. 1438 the Adige broke its levees and poured its waters south into the Castagnoro and Canale Bianco, which then formed a drainage stream parallel to the Po. In 1545 the break had so increased that two-thirds of the low-water flow of the Adige and three-fourths of the high-water flow went through it. A low dam was built across the Castagnoro to check the flow into it, and both rivers raised their beds. In 1678 a new dam was built, as the old one was then buried in the deposit. The bed still rose. In 1791 a masonry dam 39 feet high, with many archways through it to allow floods to pass, was built across the Castagnoro. The bed continued to rise, and the floods on the Adige were so high that in 1838 the Castagnoro was permanently closed. In the six years following the closure the floods in the Adige fell, and the more markedly the nearer the point considered was to the Castagnoro.

Thus far only outlets have been considered which are permanent rivers. For such outlets the effect in finally raising the flood surface of the main river will be the greater as the flow of the outlet is more nearly equal to the remaining flow in the main river. If the outlet is small, its effect on the main river will be small.

Places where there is no escape except at high stages are sometimes called outlets. For many years prior to the recent closing of levee gaps along the Mississippi below Red River, and of the gaps which permitted water to escape from the vicinity of Turnbills Island into the Atchafalaya Basin, the maximum flood flow past New Orleans was but about 1,100,000 cubic feet per second. This flow is ample for all navigation purposes, and no practical gain to navigation will result from increasing it. In 1882 it was estimated that about 2,200,000 cubic feet per second passed the latitude of Red River mouth. It has been proposed to allow only 200,000

cubic feet per second to go down the Atchafalaya, leaving 1,900,000 or 2,000,000 cubic feet per second to go down the main river.

In my judgment until the heights of levees below Red River are largely increased, there should be left a free opportunity for the escape overland of 400,000 cubic feet per second from the vicinity of Turnbolls Island into the Atchafalaya Basin, in such floods as those of 1882, in addition to the 200,000 cubic feet per second which is to go down the Atchafalaya. If such an escape, existing only at high water, be called an outlet, then I think it necessary, at least for the present. It will do no harm to navigation, which was good enough for many years before the escape into the Atchafalaya Basin was reduced. On the other hand, to try to force in a great flood, 1,900,000 cubic feet per second past New Orleans, with levees at present heights, is sure to renew the disasters to levees at or below Red River which have occurred this year. The injury resulting from many breaks below Red River is so much greater than that resulting from the escape into the Atchafalaya Basin from the vicinity of Turnbull's Island that the lesser interest should yield to the greater until it is possible to protect both.

It may be concluded, then, that the reduction, by any large amount, of the flow of the Mississippi at Lake Borgne below what it has been for many years will be ultimately followed by a rise in the flood heights at that place and a shoaling of the river below and at its mouth.

Also that until levees below Red River are much higher than they are now, about 600,000 feet per second in the greatest floods should be allowed to go into the Atchafalaya Basin, thus relieving the river below.

The opinion that the head of the Atchafalaya Basin should not be closed by levees was urged by me in the annual report of the Mississippi River Commission for 1884.

There is one other question, and that is that leveed rivers raise their beds higher and higher as the levees are raised. That is a very essential question in levees as long as are those on the Mississippi, and I have some memoranda as to them which I can read to the committee.

The CHAIRMAN. The statement has been made that the bed of the Mississippi River has risen some seven or eight feet.

General COMSTOCK. I have heard that. I have examined that question also. I have prepared a statement as to that question.

The statement is often made that leveed rivers raise their beds higher and higher as levees are raised, and hence that levees will give no permanent relief against overflow. These statements are usually made from theoretical opinions and without a thorough knowledge of the theoretical side of the subject, and probably without any knowledge of the facts of experience, which alone can lead

to conclusions entirely safe. The river Po has long been leveed, and it is often stated that its bed has risen largely in consequence of levees. The following data will show how unfounded is the statement that the bed has risen by amounts that are of much importance:

At the revival of civilization the levees on the Po were complete and continuous from Cremona to the mouth of the Oglio, 49 kilometers, or 58.4 miles. About A. D. 1300 they were carried farther down the river, and in the succeeding centuries to near its mouth. In the present century levees have been systematized as to height. Four hundred kilometers, or 248½ miles, were below the flood of 1872. At the end of 1877 it was expected to reduce this to about 30 kilometers, or 18 miles. (*Cenni monografici sull' idraulica fluviale in Italia. Roma, 1878.*)

Zendrini, in 1720, observed an extreme low water at Ponte Lagoscuro, only .36 foot less than that of 1817; and at the dam of Governolo, near the mouth of the Mincio, the river was 1.3 feet lower than a stage of water of 1609, declared by Bardazzoli to be marvelous (*Lombardini, Notizii*).

The above gauge readings, which have been only kept since 1807, show that there has been no important rise of the bed of the river (since that could not rise without raising the low-water surface) at Pontelagoscuro in the sixty-eight years covered; and in connection with Zendrini's observations, show that there has been no probable rise of any importance since 1720, although the raising of levees has been going on during this period. Lombardini (*Dei Congiamenti del Po, 1852, p. 17*) examines this question for points above Pontelagoscuro, which itself is 92 kilometers (57 miles) from the mouth of the Po. He concludes that at Ostiglia, which is 183 kilometers (114 miles) above the mouth, the bed appears to have risen a few decimeters (decimeter = 3.9 inches) in a century, while at Governolo, 15 kilometers (9 1/3 miles) above, it appears to have been stationary for four centuries.

Comparing the means from 1817 to 1850 with those from 1851 to 1867, it will be seen that a small rise in low-water heights is indicated, but the observations at several stations in the first period were few, and hence the results are uncertain.

The flood heights have, however, steadily risen. The following greatest floods are recorded:

	M.	Ft.
1837-1877.....	3.22	= 10.6 in the year 1872
1757-1796.....	2.15	= 7.1 in the year 1777
1797-1836.....	2.68	= 8.8 in the year 1833
1837-1877.....	3.22	= 10.6 in the year 1872

From this table it appears that the highest floods have increased in height since 1705 by 1.4 meters (4.6 feet). The rise in flood

heights on the Po has not been confined to the single Pontelgoscurio, but has extended far above.

Gallizia (*Giornale del genio civile*, February, 1878) examines this question and gives the following results. The miles given are reckoned from the mouth of the river.

"At Becca (394 kilometers, or 245 miles), within the century, there is a progressive rise of 1.53 meters (5 ft.) from 1801 to 1857; at Corossa (337 kilometers, or 209 miles), the flood of 1801 read 6.35 meters, and their heights rose gradually to 7.95 meters in 1872, or to 7.45 meters if allowance is made for a change of bed at this place. At Casal Maggivre (233 kilometers, or 145 miles), from 5.60 meters in 1801, the floods rose gradually to 6.07 meters in 1868, a rise of 0.47 meters or 1.5 feet. At Ostiglia (149 kilometers, or 93 miles), from 6.80 meters in 1801, and 7.50 meters in 1812 to 8.56 meters, although the river was not entirely confined. At Pontelgoscurio (92 kilometers, or 57 miles), from 2.19 meters *sopra guardia*, in 1801, to 3.32 meters in 1872; the river not being entirely confined in this last year—a rise of 1.13 meters (3.7 feet); so that on the average there has certainly been a rise of more than a meter (3.28 feet) in the last seventy-five years along the whole course of the leveed river, excluding the Parma Cremona front, where the levees are far apart, and the rise is about one-half as much."

Cenni Monografici sull'idraulica, p. 59, attributes the increased heights of the great flood of 1839 to "the more perfect leveeing of the Po and its tributaries, preventing the lateral escape of the waters, and sending in a canal to the sea that which previously flowed over the country."

Lombardini (*Il grande estuario Adriatico*, p. 96) says the increased floods "arise in part from levees which hinder their spreading out, and also from the deforesting of mountain slopes."

Gallizia (*loc. cit.*) attributes increase of floods to deforesting, to the interest each one has to get rid of injurious water, without consideration for those below him, to the leveeing of upper parts of rivers and their tributaries, and to the extension of the river mouth into the sea.

To sum up in reference to the Po, it may be said that during the present century the levees on the Po have been systematized and raised to follow an increase in flood height that in seventy-five years amounted to about three feet along the leveed portion of the river; and that there is some evidence of a small rise in the extreme low-water surface of the river, which may be caused by a rise of the bed. It should be noticed, however, that the rise in the bed (if it really exists) amounts to only two-hundredths of a foot a year, and that the annual cost of raising levees to keep up with it would be but a small part of the annual cost of a complete system of levees.

As to the rise in the flood level as the waters are more and more thoroughly confined, it may be said that this was a necessary result of confinement; that the same thing occurs on the Mississippi, and that it will cease when the levees have been built high enough to contain the greatest floods.

On the Po thus far during the last seventy-five years the effect of the confinement of waters in raising the flood level has far exceeded any tendency that confinement may have had to reduce flood heights by scouring the bed.

Senator WASHBURN. Are the conditions the same in the valley of the Po as in the Mississippi Valley?

General COMSTOCK. Yes, sir; essentially the same; an alluvial stream.

Senator CULLOM. So that your conclusion is that the bed of the river has not risen?

General COMSTOCK. Not to any considerable amount; not to exceed 6 or 8 inches.

Senator CULLOM. For how long a period?

General COMSTOCK. From seventy-five to one hundred years.

Senator CULLOM. Oh, that is the Po. What is the fact with reference to the Mississippi River?

General COMSTOCK. Our records of low water run back only twenty-five or thirty years. Our records do not go back far enough to draw an intelligent conclusion. You want a period of from seventy-five to one hundred years to say positively whether any changes have occurred.

The Rhine is also a river which, below Dusseldorf, has long been leveed, and if levees raise the bed of a river here, they should have produced their full effects, as they are rarely broken.

It will be seen that the low-water surface appears to have fallen in the last hundred years at Emmerich, and possibly at Cologne.

Hagen (*Wasserstände in den Preussischen Strömen*, p. 12) carefully examines the gauge readings at Cologne, from 1846 to 1879, and at Düsseldorf from 1800 to 1879, to detect changes in high and low water heights. Treating the gauge reading by the method of least squares, he found the most probable annual change in the water heights. At Düsseldorf he found that, with great probability, there was an annual sinking of the maximum high water in each year amounting to 0.3 inch; that the mean stage did not change, and that the annual lowest waters showed, with some probability, an annual rise of one-twelfth of an inch.

For Cologne he found that, with great probability, the high waters had sunk, and the lowest waters has risen by about the same amounts as at Düsseldorf. A rise of one-twelfth of an inch a year, or 8 inches in a hundred years, is so small as not to be an im-

portant matter in a system of levees; and if the hundred years of the table above are taken, this rise disappears.

It has often been asserted that the bed of the Hoang Ho, or Yellow River of China, has risen above the surrounding country, where it is leveed. The error, originally due to Abbé Huc, has been repeated by English writers on China. The following extract from a letter to me by Gen. J. H. Wilson (a very competent authority) gives reliable information on the subject:

WILMINGTON, DEL., May 6, 1890.

* * * * *

In reply I hasten to say that I crossed the Yellow River on the 7th of January, 1866, near the city of Kai-fong-fu, in the province of Honan, and visited the site of the great break of 1853, about 30 miles below Kai-fong-fu; also traversed its embankments or levees on both banks of the river, visiting and measuring them at various points between Kai-fong-fu and Chinan-fu in the province of Shan-Toong, taking observations, notes, and measurements, and having specially in view the repair and maintenance of the embankments, their present condition, and the effects produced by them. I had no instruments, however, except a hand level, sextant, and tape line, and could therefore make no accurate levels across embankments, bed of the stream, fore shores, and adjacent plains, but the conclusion I came to in regard to the influence of the levees upon the bed of the river was that they had nowhere filled it to a higher level than the adjacent country. I had heard of Father Huc's narrative on that point, and I visited the plain at which the river had left its old channel in 1853, leading to the sea south of the peninsula of Shan-Toong, and made itself an absolutely new one to the Gulf of Pe Chi Li, north of that peninsula. Between this place—known on the maps of Asia (Kirke Johnson's is the best) as Lung mum Ku—and Kai-fong-fu, the embankment was very large, but it was near the latter place that the great break occurred two years ago. This was closed after incredible efforts and great expense, and this river forced to resume its old channel, where it is now emptying itself, according to my advices of a few months ago, and where it will most probably continue to empty itself till it can find a shorter line and steeper declivity to tide level.

By referring to my little book on China (Appleton & Co.), you will get other details.

In conclusion I do not hesitate to say that I can not believe that Abbé Huc was entirely mistaken in regard to the silting up of the channel, and that an exhaustive survey would prove beyond a doubt that no such silting as to raise any part of the bed above the adjacent country has ever taken place.

Yours, very truly,

JAMES H. WILSON.

The question of the rise of bed of the Mississippi will now be considered. Unfortunately it has not been studied as thoroughly as the Rhine and Po, and its gauge records go back but a few decades.

Levee building has gone on most rapidly since 1880, and as the river was very low in December and January, 1887-88, and again in October and November, 1889, if there has been any important rise in the river bed resulting therefrom it should show itself in a corresponding rise in the extreme low-water surface.

Several places will be considered, selecting those where our gauge records cover as many years as possible.

(1) *Cairo*.—The lowest water record extends back to 1859, with breaks, but is continuous since 1871. January 1, 1888, the gauge read 1.8 feet, and October 22, 1889, it read 2.7 feet. From November 10, 1859, to these dates the record gives but three years when the water was as low as in 1888 and 1889. These years were:

	<i>Feet.</i>
December 26, 1871; Cairo gauge.....	—1.0
December 6, 1872; Cairo gauge.....	1.0
January 1, 1877; Cairo gauge.....	1.0

These gauge readings are lower than those of 1888 and 1889, but the period since 1880 is entirely too short to conclude that in it there was a year in which the discharge reached its lowest value, thus giving extreme low water. The greater low-water heights in 1888 and 1889 may be simply due to there being more water flowing in the river at those times than in 1871. If in seventeen years following 1888 there are no gauge readings as low as those of 1871, 1872, and 1877, it will in some degree indicate but not prove that the bed has risen. At present the data do not extend over a period long enough to draw any reliable conclusions.

(2) *Memphis*.—This gauge read:

	<i>Feet.</i>
November 20, 1887.....	1.20
January 4, 1888.....	0.80
October 26, 1889.....	1.90

The records of low water before these dates extend back to 1848 and are continuous back to 1871. The records back to 1848 give but three dates when the water was lower than on January 4, 1888, namely, 0.80 feet. These dates are;

December 29, 1871.....	—0.92
December 25, 1872.....	—0.95
January 2, 1877.....	+ .75

Here again the extremely low waters of 1871 and 1872 show themselves, and they are lower than any since 1880. But, as was said in reference to Cairo, the period since 1880 is entirely too short to enable us to assume that in it there has been a year of minimum

flow, or, what amounts to the same thing, that there will not in a few years occur a stage as low as that of December 29, 1871.

(3) *Helena*.—The low-water record is continuous, excepting 1878 and 1879, back to 1871. The gauge read:

	Feet.
December 29, 1871.....	1.15
December 26, 1872.....	0.00

The record afterwards gives no waters as low as these till 1887. The gauge read:

	Feet.
November 20, 1887.....	1.20
January 4, 1888.....	0.80

Comparison of the two periods gives a difference too small to establish a rise of low-water level.

(4) *Lake Providence*.—The low-water record extends back to 1872 and the lowest waters are:

	Feet.
December 29, 1872... ..	—3.85
October 16, 1879.....	0.55

Since 1880 the two lowest waters are:

	Feet.
November 22, 1887.....	1.52
October 31, 1889.....	2.80

There seems to have been a great depression of low water in this part of the river about 1872. The Terrapin Neck cut-off, shortening the river about 16 miles, occurred in 1866 and may have been a partial cause. The gauge readings given indicate a rise in the water surface and probably of the bed at Lake Providence since 1872.

(5) *Vicksburg*.—Excepting 1878 and 1879, the low-water record is continuous back to 1872. The gauge read:

	Feet.
December 30, 1872.....	—1.30

From this date to 1886 the lowest record is:

	Feet.
January 6, 1887.....	2.25

Since 1880 we have:

	Feet.
November 16, 1886.....	0.00
November 24, 1887.....	3.91
January 7, 1888.....	1.32
October 29, 1889.....	0.80

Here the gauge records indicate a fall in the low-water surface and perhaps a fall in the bed. The question is complicated by the Terrapin Neck cut-off of 1866, the Vicksburg cut-off of 1876, and the Davis Island cut-off of 1867.

From 1872 to 1881 the low-water fall in the surface of the river between Lake Providence and Vicksburg varied between 21.0 feet and 22.9 feet; in 1883 it was 24.9; in 1886, 26.2; in 1887, 29.0; in 1888, 26.7, and in 1889, 27.2 feet. The change of fall from 22.6 feet in 1887 to 29.0 feet in 1887, amounting to 6.4 feet is very great. About two-thirds appear to be due to a sinking of the low-water plane at Vicksburg, and the rest to a rise in the low-water plane at Lake Providence. The low-water slope from Lake Providence to Vicksburg was in 1884 still much greater than just above or below. Its great value was probably due to the cut-offs. In 1884 the distance from Lake Providence to Vicksburg was 57 miles; the sum of the two cut-offs was 18 miles. If we suppose that before these two cut-offs the river was two-thirds of this 18 miles longer than now, or the distance from Lake Providence to Vicksburg to have been 69 miles, the slope would have been but fifty-seven sixty-ninths of its present value. The result of the cut-offs would be to increase the velocity of the river above and near them. This increase of velocity would tend to scour the bed and banks, perhaps making a deposit in the river below the Davis cut-off, and temporarily raising the bed there; and it may be that it is now returning to its normal low-water position by removing the deposits below.

(6) *Red River Landing*.—The low-water record is continuous back to 1872, which was the year of the lowest known low water, the gauge reading 0.0. In 1879 it fell as low as 0.55, and in 1887 to 0.47. The difference in low-water heights of 1872 and 1887 is too small to be evidence of a rise in the bed of the river.

Thus far only low waters of the Mississippi have been considered. The high-water records cover longer periods, but as an increased high water may result from confining the floods between lines, as well as from a rise of the bed of the river, it can not be concluded from a rise of flood height in the river that the bed has also risen. At Cairo—

	Feet.
June 21, 1858, the gauge read.....	49.6
May 2, 1862.....	50.8
March 21, 1867.....	51.0

The river did not again reach these heights till—

February 26, 1882.....	51.87
February 27, 1883.....	52.17

This increase in the later heights is not supposed to indicate any rise of bed, but can be accounted for solely by a greater flood discharge.

At Memphis the record goes back to 1828. In 1862 the river reached a flood height of 34.45, the record then showing no greater one. In 1882 the greatest height was 35.15; in 1887, 35.30; and in 1890, 35.60. This rise of 1.1 feet since 1862 may be accounted for

by a greater discharge, by the construction of levees below Memphis, and, perhaps by the influence of railroads across the St. Francis bottom, without the supposition of a rise of bed.

At Vicksburg the record goes back to 1828. The highest known water was 51.1 feet, in 1862. The next highest was 49.1, March 15, 1890. Here there is no indication of a rise of bed.

At Natchez the record goes back to 1802. The highest water was 49.9, in 1862. In 1890 the highest water was 48.6 on March 22. In 1815 the highest water was 48.5. There is no indication of a rise of bed.

From an examination of the Po and Rhine, it may be concluded that if their beds rise in the leveed portions (which is not entirely certain from the data), it is at so slow a rate as not to be an important factor in the maintenance of a levee system. With levees 10 feet high, if the bed rose at the rate of 1 foot in a hundred years, the cost of raising a line of levees having the length of the present Mississippi system—about 1,300 miles—by this 1 foot, would be but about \$4,000,000, distributed over the country, or \$40,000 per annum, which is a small part of the annual cost of the system.

On the Mississippi, the records, while not extending over a period long enough to give final results, do not, so far as they go, indicate that the bed has risen.

The opinion so often held, that levees cause a river bed to rise, is probably due to the fact that the bed of a river does sometimes rise, although leveed, and hence it is concluded that the levees cause the rise. Any sedimentary stream, having a definite succession of stages and discharges, and flowing in its own alluvion, finally takes such a slope as will give a velocity sufficient to enable it to carry its sediment, whether derived from above or from its own banks and bed farther down stream, without, on the whole, scouring or filling its bed. An average velocity less than this will give rise to deposits in its bed, or if it is crooked, it will become straight, thus in either case increasing its slope and velocity toward their normal values. An average velocity greater than this will scour its bed or cause caving in its convex bends, thus increasing its length and diminishing its slope and velocity to such values as its bed can bear without, on the whole, scouring or filling. When, therefore, the slope of a sedimentary stream suddenly diminishes from that which it needs for a stable regimen, its velocity also diminishes; it drops a part of its alluvion, and its bed rises. Thus, when the Mississippi enters the Gulf of Mexico, its slope suddenly diminishes, its velocity diminishes, and it builds up bars out in deep water. So Bayou Lafourche, when its waters fall to the level of swamps but a few feet above Gulf level, builds up its bed, necessitating high levees. So, too, the Adige, where it reaches the low plains of the Po, needs for

permanence a steeper slope than the country has, and raises its bed above it. In all these cases the bed would rise without levees.

There is one more cause for the rise of bed of a sedimenatry river, which, however, acts at a very slow rate. The Mississippi pushes its mouths out into the Gulf at the rate of about 4 miles in a century, and this increase in length requires a corresponding increase in fall of water surface to make the waters flow out. An increase of 4 miles in length would, with existing slopes, raise the high-water surface at New Orleans about 0.7 foot. The cost of raising levees to correspond with this rise per century in the water surface would, as has already been seen, be a small part of the annual cost of the system.

It has often been asserted that the bed of the Hoang Ho, or Yellow River, of China, has risen above the surrounding country where it is leveed, and is causing trouble. I wrote to General Wilson in reference to that, and he told me some time ago about it, and he assures me that he examined that river with reference to levees at a number of points; that the test he made was by using a hand level, tape lines, and sextant, and in his opinion at no place is the bed of the Hoang Ho River as high as the surrounding country.

Senator WASHBURN. He thinks that the bed has not risen since the levees have been built.

General COMSTOCK. The levees have been there for hundreds of years, but the bed of the river has at no place risen to a higher level than the surrounding country.

The CHAIRMAN. The levees on that river are very high?

General COMSTOCK. Yes, sir.

The CHAIRMAN. The Chinese minister wrote to some gentleman the other day that they were as high as the dwellings.

General COMSTOCK. Yes, sir. He speaks of the break that happened a few years ago, and he says it was of an enormous extent. Now, with reference to the Mississippi River at Cairo, it was minus 1 foot in 1871, which was the lowest ever known. In January, 1888, it went down 1.8 feet, so that in 1871 it was about 2.8 feet lower than it was in 1888. That may indicate some slight rise in the bed of the river, there, but it is equally possible that it was due to the fact that in 1888 the river was larger than it was in 1881—that is, the river flow was larger.

Of course the height of this low-water surface depends upon the volume of water that runs through it. Sometimes the river builds bars across itself which makes the water rise higher. I do not think we have any evidence to show that the river has risen at Cairo, but if you find that the lowest water in 1888 is 2.8 feet higher than it was in 1871, which covers a period of seventeen years, then if in seventeen years more it does not fall as low as in 1871, there will be some evidence that the river bed has risen.

At Memphis that same year the low water produced a somewhat similar result. In January, 1888, the river was eight-tenths of a foot on the gauge. In 1871 it was minus ninety-two hundredths; that is the difference of 1.7 feet. These same remarks might be applied as well to the other. So far as figures go it indicates a slight rise there. From Cairo to Memphis there have been no levees.

At Vicksburg—the lowest water in 1872—the gauge was minus 1.3 feet. November 24, 1887, it was minus 3.91 feet—that is to say, the lowest water there was 2.6 lower at Vicksburg in 1887 than it was in 1871. It is due to the cut-offs which occurred there in 1876, 1866, and 1867.

Senator CULLOM. If it meant anything more than local causes it would reduce the bed of the river below, and there you have levees.

General COMSTOCK. Yes, sir; and it has got down 2.6 feet.

At Red River the low-water record is continuous back to 1872. In 1872 it fell to zero and in 1887 to forty-seven hundredths, so that the river in 1887 was only four-tenths higher than it was in 1872. So that it can be safely said, so far as our records go, and that is the most reliable information existing, there is no certain rise in the bed of the Mississippi at any point, even at Cairo. I am not sure but that that may be due to difference of discharge. The river has not been completely leveed there.

Senator CULLOM. Would leveeing below have any effect upon the river at Cairo?

General COMSTOCK. Nothing to speak of. It is only continuous when you get down to Arkansas City, which is 438 miles below Cairo.

The CHAIRMAN. It is stated in some of these papers that the Eads jetties for narrowing the river there have reduced the stream and have raised the bottom of the river above it. What have you to say as to that?

General COMSTOCK. I would attach no value whatever to such a statement as that, unless the figures were given to me, and I should not believe it even then.

Senator CULLOM. Do you mean the figures of the cause?

General COMSTOCK. I mean the figures—that is to say, if you put any obstruction in the river you would raise the water above it in some small degree. I do not suppose it is possible that these jetties have raised the river at New Orleans by 2 inches.

Senator WASHBURN. We had Captain Leathers before the committee the other day, and I asked him this question:

“As I understand the theory of the Mississippi River Commission, the theory upon which appropriations have been made, it has been that of contracting the river, contracting the current so as to

wash out and lower the bed of the river, and in consequence give a greater depth of navigable water?

"Senator GIBSON. The theory, Senator, is this: Not to contract it beyond its natural limits, but to keep it within its natural banks.

"Senator WASHBURN. From your experience is that the effect it has had, to lower the bed of the river, or has the bed of the river been raised?

"Mr. LEATHERS. As you have contracted you have filled the bottom, and you have elevated the surface. I think that the work which has been done by the Commission has been a disastrous thing to the people in the valley. I have seen no improvement there whatever towards that. We have got for navigable purposes three or four feet more water going to sea than we ever had, but it has been at the expense of the planters in the valley, putting five or six feet of water on them."

NOW, the statement, as the chairman has just remarked, has been made here repeatedly that the result of these levees had been to raise the bottom of the river from 6 to 7 feet. You state that is not the fact, do you?

General COMSTOCK. It is not the fact.

Senator WASHBURN. As a matter of fact it has not been raised at all?

General COMSTOCK. I do think it has. I have not formed any certain conclusion that it has been raised at all. As to the rise in high-water surface I have no doubt that the perfecting of the levees has raised the water.

The CHAIRMAN. To what expense have you gone to in building the levees?

General COMSTOCK. About three millions of dollars.

The CHAIRMAN. With reference to navigation alone?

General COMSTOCK. That is the way the Commission has construed the law. The law provides that it shall not be spent on levees except as a part of the plan to improve navigation, etc.

The CHAIRMAN. What would be the effect of leveeing the Mississippi River from top to bottom?

General COMSTOCK. In what respect?

The CHAIRMAN. As to navigation.

General COMSTOCK. I do not think it would improve it sufficiently to make that in any degree an economical method of improving the river.

The CHAIRMAN. You resort to other methods?

General COMSTOCK. I would resort to the other method.

Senator CULLOM. Which other method?

General COMSTOCK. Works in the bed of the river—spurs, dikes, and revetments.

The CHAIRMAN. Then you would have to build levees?

General COMSTOCK. Not necessarily.

The CHAIRMAN. You would not build levees?

General COMSTOCK. Under the law, as it is now I should not build levees, according to my idea of the effects of levees. Of course, I am a minority of the Commission. The majority of the Commission think the river can be improved by building levees. My own individual opinion is that levees are too expensive a way of improving the river to justify it under the law, and I am not sure that they would improve it at all.

Senator WASHBURN. In some places the only improvement would be in levees. For instance, at Plum Point and Lake Providence Reach.

General COMSTOCK. Our improvements are at Lake Providence Reach, but the main works are in the river and are not levees.

Senator CULLOM. You do not believe in the levee system, as a matter of fact?

General COMSTOCK. I believe in it implicitly. I think it is necessary to build them in order to take care of the country. I do not think the United States should put them there at their own expense, for navigation purposes.

Senator CULLOM. But for the general good of the country, its development, etc., you believe in levees?

General COMSTOCK. Of course I do. It always seemed to me that the Italian way was a fair one. On the important rivers they have adopted the principle that the people interested should pay the bills, and so the State assumes the cost to the extent of one-half and the Province assumes the cost of one-quarter, by taxation. Besides that they have associations of men called *Consortzii*, and these *Consortzii* pay the other one-fourth. So that the State pays one-half of the whole amount. On the Mississippi River, as the thing actually works, the State and local authorities have been paying two-thirds since 1880 and the United States one-third. There have been \$10,000,000 spent on the river since 1880, and of that amount the United States paid one-third.

Senator WASHBURN. Suppose the Government should appropriate the money to build levees the entire length of the river beyond Cairo, of a width I think you agreed on 3,600 feet. That is the general width to which you would contract the river.

General COMSTOCK. In my judgment the farther apart the levees the better.

Senator WASHBURN. In many places the width is 3,600 feet.

General COMSTOCK. That is low water.

Senator WASHBURN. Assuming that that was done, are not there periods of time in the year when that length would not be sufficient to hold the water within the banks of the river?

General COMSTOCK. It depends upon how high you build the levees.

Senator WASHBURN. At any reasonable height?

General COMSTOCK. I think they are building them from 10 to 13 feet.

Senator WASHBURN. What was the occasion of the breaks this spring below Red River?

General COMSTOCK. This flood in the upper river, at Helena, for instance, appears to have been somewhat less than the flood of 1882. At Red River, from the information that Captain Kingman gives me this morning, it would seem to be nearly equal to the flood of 1882. In 1882 about 600,000 cubic feet a second went from the Red River into the head of the Atchafalaya basin and escaped into the Mississippi. Levees were built across the head of that basin subsequently, and if they stood of course they were going to force this 600,000 feet, less what was allowed to go down the Atchafalaya proper, down past New Orleans. The effect of keeping those levees intact is to throw a greater strain on the levees directly below Red River.

I have not the definite data now at hand, and of course my opinion is not final, but I think these levees on the Atchafalaya broke sooner than on the Mississippi below Red River. I believe the levees at the head of Atchafalaya should let 600,000 cubic feet of water escape down there. In addition to that, I would raise the levees below Red River.

Senator WASHBURN. Your answer to my question, then, would be that the river, if it were leveed the whole distance, would not carry the entire volume of water.

General COMSTOCK. Oh, yes.

Senator WASHBURN. But you would relieve it by opening up the Atchafalaya?

General COMSTOCK. That would be the way.

The CHAIRMAN. If there were money enough there would be no difficulty in putting them at a height that would raise the river?

General COMSTOCK. I think not.

The CHAIRMAN. Have you compared the overflows on the Mississippi River during the last fifteen or twenty years with this last one?

General COMSTOCK. Our data of the overflows are very meager, except with reference to the flood of 1882, which was a great one. All the data are not in. I have not received them as yet in reference to this present flood. As I said before, at Helena the maximum flow appears to two hundred or three hundred thousand cubic feet a second less than in 1882. At Red River it was about equal to that of 1882. Both of these were great flood years.

The CHAIRMAN. Do you know how the country inundated appeared in 1882 as compared with that country this year?

General COMSTOCK. There was no comparison whatever. At that time the levees were broken from Cairo down to Bonnet Carre. The country was overflowed from Cairo to the Gulf, and the damage was greatly less in 1890 than it was in 1882.

Senator CULLOM. Now, for navigation purposes, have you any idea what amount of money would be necessary to be spent to make that river as good as it can be made?

General COMSTOCK. I have estimated it in the neighborhood of \$75,000,000.

Senator CULLOM. For navigation purposes purely?

General COMSTOCK. Yes, sir.

Senator CULLOM. Without reference to river interests?

General COMSTOCK. Yes, sir.

Senator CULLOM. How much would it cost to levee it?

General COMSTOCK. There has been no estimate made of that at all.

The CHAIRMAN. Suppose you built the levees at the same time, what would it cost?

General COMSTOCK. So far as getting ten feet of water, it might take off \$10,000,000.

The CHAIRMAN. It would take off \$10,000,000.

General COMSTOCK. The works on the bed of the river might cost \$10,000,000 less if you made a perfect system of levees.

The CHAIRMAN. How much does the perfect system of levees add?

General COMSTOCK. There has been no estimate made of it. The Commission made an estimate in 1884 and 1885, I think, of levees at a certain height, at \$11,000,000. I think that is too small for a perfect system of levees.

Senator WASHBURN. You say to build levees would diminish the amount already mentioned in improving the level of the river.

General COMSTOCK. As I said before, I do not know whether levees would improve navigation. I said that the building of levees might make the navigation improvement cost ten million dollars less, or sixty-five millions of dollars, but I have no certainty that it would.

Senator CULLOM. Have you gone over the system that you would adopt if you had your own way with reference to the improvement of the river for navigation purposes?

General COMSTOCK. Yes, sir.

Senator WASHBURN. That is by making improvements in the bed of the river and not by building levees?

General COMSTOCK. Yes, sir.

Senator WASHBURN. The building of the levees the entire distance would not obviate the necessity of making these improvements in the bed of the river that you are now doing?

General COMSTOCK. I think not.

Senator WASHBURN. Now, the effect of relieving the river at the Atchafalaya has been good, as I understand you.

General COMSTOCK. The effect of what?

Senator WASHBURN. The effect on the Atchafalaya outlet by relieving the Mississippi of, say, one-fourth of the discharge, the result has been good, has it not?

General COMSTOCK. No. I can hardly say that the result has been good, because the levees broke in 1882. When that was entirely open the levees broke.

Senator WASHBURN. You would relieve the river of so much water?

General COMSTOCK. Yes, sir; but the amount that should be raised would be small in comparison with what would be necessary to bring the water down the main river.

Senator WASHBURN. Would you recommend the closing entirely of the Atchafalaya outlet, assuming that you had money enough to build the levees high enough below?

General COMSTOCK. No, I do not think it would. It depends upon the country back there.

Senator GIBSON. As I understand it, the Atchafalaya is not, strictly speaking, an outlet of the Mississippi. It is both an outlet and an inlet. At certain times when the Tensas Valley basin is full of water, and the Red River is full, it is an inlet into the Mississippi River; it empties into it. I suppose it is doing that now, and during the flood season it has been a tributary of the Mississippi River—I mean the Red River has. But the function that the Atchafalaya performs is to take off water that otherwise would go into the river.

General COMSTOCK. Yes, sir.

Senator GIBSON. From the Tensas Basin and from the Red River.

General COMSTOCK. All of that would become part of the Mississippi River below it.

Senator GIBSON. Assuming that that is the case, why would not the opening of the Lake Borgne outlet have the same effect by relieving the river by discharge?

General COMSTOCK. If you were to make an opening of the same size, the first question would be how low down you would have that opening.

Senator GIBSON. No; what you would call a high-water opening?

General COMSTOCK. That is about the level of the banks. For that purpose it would give some relief. But at Lake Borgne the

rise and fall of the river is only something like 12 feet perhaps, so that if you stop your sills at 9 or 10 feet above low water it would require one a good many miles long, which would require expensive work.

Senator GIBSON. How deep an outlet could you have there without interfering with the river below; not to shoal up the river and affect the navigation below?

General COMSTOCK. It is possible you might take 100,000 feet a second. The flow has been about 1,100,000 feet a second. This year it has been more. You might take 100,000 without injuring the South Pass. I do not think you would gain enough by that experiment to balance the danger you run.

Senator GIBSON. How far is it from the point on the Mississippi River where it is proposed to make the Lake Borgne outlet to deep water?

General COMSTOCK. I do not recollect the distance exactly. I think it is something like 60 or 70 miles. From Lake Borgne to the Mississippi Sound the water is from 10 to 12 feet to 20 feet deep, while the main river at Lake Borgne down to the head of the pass is probably 100 feet deep.

Senator GIBSON. How far is it from Lake Borgne to deep water?

General COMSTOCK. About 100 miles to the jetties.

Senator GIBSON. What would be the damage likely to be inflicted upon the city of New Orleans and upon the people in that vicinity by making an outlet into Lake Borgne?

General COMSTOCK. It would raise the water there by a number of feet.

Senator GIBSON. Would not that necessitate the leveeing in of the whole rear of the city of New Orleans?

General COMSTOCK. I think so. The dams would be overflowed and raise the water in Lake Borgne.

Senator GIBSON. You have spoken of the River Rhine and the River Po. Is not there a great deal of gravel in the River Rhine, and more gravel in the River Rhine than in the Mississippi River in proportion to size and the volume of water?

General COMSTOCK. When you get down towards the boundary of Holland I think there is not much besides sand. As you go up it is possible that there is a little gravel there, as there is in the Mississippi River down as far as Profit Island.

Senator GIBSON. Have they not taken in vast tracts of country on the Rhine by sharpening the river?

General COMSTOCK. There has been a good deal of cut-off work done above the region of levees on the Baden frontier.

Senator GIBSON. If you were to construct this outlet at Lake Borgne, how far would you think it necessary to levee that outlet to prevent it from overflowing the whole country?

General COMSTOCK. You would have to levee it all around; I think all the way around Lake Borgne.

Senator GIBSON. How would you levee Lake Borgne?

General COMSTOCK. I consider that so foolish that I have not given it a thought.

Senator GIBSON. Would not the secondary effect of this outlet be to fill up that basin with sediment?

General COMSTOCK. The velocity in Lake Borgne would at first be one-sixth of that which it is in the main river, and of course a large portion of the Mississippi sediment would drop into Lake Borgne.

Senator GIBSON. You have been down to the forts there, have you not?

General COMSTOCK. Yes, sir.

Senator GIBSON. Do you know a place called Cubitt's Gap?

General COMSTOCK. Yes, sir.

Senator GIBSON. Was not that originally an outlet to the deep water of the Gulf, right above the Gulf, on the right-hand side?

General COMSTOCK. Yes, sir; on the left bank.

Senator GIBSON. It is on the right-hand side going down the river.

General COMSTOCK. That is the Jump.

Senator GIBSON. What has been the effect of building these outlets?

General COMSTOCK. The effect has been to build a bar.

Senator GIBSON. Has not the river really closed them up?

General COMSTOCK. I think they are very much closed up. I have not seen a survey of them for many years.

Senator WASHBURN. What is the distance from the Lake Borgne outlet where you would start off from the Mississippi River to the deep water of the Gulf; what would be the distance across there?

General COMSTOCK. My recollection is it is something like 60 or 70 miles.

Senator WASHBURN. What is the distance from that same point to an outlet at the jetties?

General COMSTOCK. About 110 miles.

Senator WASHBURN. Then the current would be very much more rapid through the Lake Borgne outlet than it is in the Mississippi?

General COMSTOCK. No, sir.

Senator WASHBURN. The fall would be much greater.

General COMSTOCK. The fall would be greater in the ratio of sixty to one hundred, but the velocity would not depend upon the fall alone. It depends just as much on the depth. You would nearly double the slope of the river, but the depth would be only one-tenth as much. The main river is 100 feet deep, and you would have to dig it out nearly to that depth to get as high velocity all the way to the sound as in the Mississippi.

Senator WASHBURN. The result would be in the first instance to fill up Lake Borgne and to cut a main channel in there, so that the objections raised by the citizens of Louisiana would not come about.

General COMSTOCK. I think that would be the result ultimately. Lake Borgne now is a very wide body of water.

Senator WASHBURN. Not very deep.

General COMSTOCK. No, but still its cross section is larger than that of the Mississippi, so that the velocity of the water flowing through it would be very much less than the Mississippi River. The process would be to shoal it up and form channels through it, and the velocity would be less.

Senator WASHBURN. There would ultimately be a distinct channel through it?

General COMSTOCK. Yes, sir.

Senator GIBSON. You said a while ago that it would cost about \$75,000,000 to complete the works on the Mississippi River. Have you ever made any estimate of what the cost would be of completing the works on the Atlantic sea-board, the improvement of the rivers and harbors?

General COMSTOCK. No, sir.

Senator GIBSON. Or on the lakes?

General COMSTOCK. No, sir.

Senator GIBSON. You said, also, that it would cost \$10,000,000 less than \$75,000,000 if we applied the levee system in conjunction with the jetty system.

General COMSTOCK. I mentioned that as possible to my mind. I really do not know.

Senator GIBSON. What benefit would it confer upon the people living on the banks of the river to have it leveed?

General COMSTOCK. The benefit would be enormous.

Senator GIBSON. What area of territory would it bring into habitation?

General COMSTOCK. Some 30,000 square miles, if the whole of it were cultivated.

Senator GIBSON. What effect would it have on the common carriers, the railroad systems?

General COMSTOCK. A very large effect. The effect of the

levees on the Yazoo River has been very large during the last few years, both in the way of river transportation and railroads.

Senator CULLOM. You say there are levees now above the level of the valley along the river?

General COMSTOCK. They are not very much more than 3 or 4 feet high in some places.

Senator CULLOM. How much of that country would be so endangered as to drive the people away and destroy the crops, stock, etc.?

General COMSTOCK. That would depend very much upon whether the levee broke and discharged the water over it. Take the Yazoo district. There is a number of drainage streams running through it into which the water flows from the Mississippi, and they have built up ridges along their banks just as the Mississippi has, and when the flood comes the water is guided by those ridges and flows into the bottom. It is almost impossible to tell what damage is going to be done in a given place by a given break, except by one thoroughly familiar with the local topography.

Senator CULLOM. Can not people, property, stock, etc., be gotten onto high spots around there, so that they can secure themselves from danger?

General COMSTOCK. Very often the levees are the only high spots.

Senator WASHBURN. Is the topography of the country such that there is any point above the Atchafalaya where an outlet could be made and the water reach the Gulf?

General COMSTOCK. I think not of any value at all. Mr. Cowdon has proposed an outlet into Bayou Bartholomew from the Arkansas River, which scheme I think is not good.

Senator WASHBURN. Why so?

General COMSTOCK. It is rather a small narrow stream there. Suppose you take 100,000 feet of water out of the Arkansas River, I doubt if you could get it to run through that stream. I am not sure you could make a canal from the Arkansas River through to Bartholomew to carry even that amount except at enormous expense.

Senator WASHBURN. During the past two or three years the levees have been closed. How has the low-water navigation been affected?

General COMSTOCK. Affected by State works or by the works of the Commission?

Senator WASHBURN. It has been affected by levees and not by jetty works, I understand; but where the river has been leveed, has the low-water navigation been improved by those levees?

General COMSTOCK. That is a question which is something like asking about the rise in the bed of the river. You want a good

many years to settle that question. The results to be effected would be the disappearance of the bars having less than 10 feet. I looked at that question some time ago with reference to the low waters of 1887, 1888, and 1889, which were quite low-water years, and nearly as low as 1871 and 1872. There were a good many bars that showed themselves in those years. Our record is not definite and precise enough to say that the bars have diminished. I do not know that except by the disappearance of the bars or by resurvey of the whole river. It can be shown that levees have improved the bars which give trouble to navigation.

With reference to the rise in the river bed, Colonel Ernst has given me some averages for a period of years. There are a number of points, taking the mean low water, that indicate that the low water has not risen.

Mr. COWDON. It has been stated that the Jump showed itself up to 4 feet at its intersection with the Mississippi River, and that was given as evidence why the Lake Borgne outlet was closed. I want some gentleman to look at this chart and see if that is correct. Some Senator get up and look at this map.

General COMSTOCK. I doubt if I gave that testimony as to being only 4 feet. I will say, speaking from recollection, that while the jetties were being built I went in there one day and was told it was filling up rapidly, and that there was great difficulty in getting a steamboat about in there.

Senator WASHBURN. How late an edition is this map?

Mr. COWDON. The first date was in 1872, and it was revised in 1884 and 1885.

General COMSTOCK. I would say that it is difficult to tell on that map when the survey was made.

Mr. COWDON. The map was made two years after the survey was made.

General COMSTOCK. It was made in 1887, but the survey may have been made ten years before. It is a Government map.

Mr. COWDON. That report was made in 1880. I went there and got the proofs. I measured it and found 56 feet of water.

General COMSTOCK. How far did you go down?

Mr. COWDON. I went down about three-quarters of a mile.

STATEMENT OF LIEUT. COL. CHARLES R. SUTER.

Lieut. Col. CHARLES R. SUTER, U. S. A., a member of the Mississippi River Commission, appeared before the committee.

The CHAIRMAN. How long have you been connected with the Mississippi River?

Lieutenant-Colonel SUTER. About twenty-four years.

Senator CULLOM. Are you a civilian?

Lieutenant-Colonel SUTER. No, sir; I am an officer of the Engineer Corps, U. S. Army.

The CHAIRMAN. Just make a general statement as General Comstock did in relation to the Mississippi River, its improvement, etc.

Lieutenant-Colonel SUTER. I presume you refer more particularly to the work of the Mississippi River Commission.

The CHAIRMAN. Yes, sir.

Lieutenant-Colonel SUTER. The Commission was organized in 1879. The first report that the Commission submitted in accordance with the law organizing it considered various plans that had been presented at various times for improving the Mississippi River. They were defined in the bill as the outlet plan, the levee plan, and what was called the jetty plan. The Commission reported upon all three plans and then made their recommendation as to what they proposed.

The so-called outlet plan was condemned *in toto*. The plan of improving the navigation by levees alone was not adopted by the Commission.

Of course, as a protection against overflow they were unanimously favored by the Commission. The closure of the then existing gaps was recommended, as it was considered that the levee system would form an important auxiliary in channel improvement when taken in connection with the other work which was recommended. The Commission were of the opinion that an approximately uniform regimen of the river should be aimed at, and that the control over the river should extend through all its stages, including high water, which of course brings in the levees as a factor in the channel improvement. I will state that when I speak of a uniform regimen of the river I mean that the object is to introduce as nearly as possible similar conditions throughout, so that there will be no abrupt changes in its main features.

The river in its present state varies from 2,000 feet to over 10,000 feet in width, with corresponding variations in velocity and everything connected with it. The idea was to bring it into something like uniformity. Of course, it was not considered advisable that the minimum width should be taken as the standard. The minimum width I think is 2,000 feet. It is not considered necessary to go that far, but the Commission found on investigation, from such surveys as were available, that a width at low water of about 3,000 feet would give sufficient depth for all navigable purposes, and the plan formulated was to reduce the river to this width at low water by proper contraction works. The kind of contraction works proposed were what may be denominated silt-catching works. They consist of systems or combinations of dikes made of piles and carrying brush screens, so designed as to check the current over certain

selected portions of the river bed and induce there deposits of silt, so that ultimately the river may rectify itself by reclaiming those portions of the bed which are not needed for the navigable channel and building up new banks. Eventually these shoals become the training dikes just as ordinary dikes do on rivers of the usual character. It is a system of improvement only possible on a sediment-bearing stream.

The second feature of the proposed plan was the revetment of banks where exposed to erosion, the idea of course being to make the current act on the bottom instead of the banks, in order to deepen the channel.

These two constitute the main elements of the channel improvement in the bed of the river; that is, permeable dikes to induce deposits, and revetments to hold the banks and keep the river in place. The maintenance of levees on the top of the banks was thought by the Commission to subserve two purposes. In some places there is very little question that the navigation of the river has been seriously deteriorated by the existence of breaks in the levee. That, of course, is especially manifest in those portions of the river that have been leveed for a long time; that is, where the system of levees has been kept up for a great many years.

It has been found by measurement that below extensive gaps in levees there is a very decided deterioration in the channel, and the Commission were of the opinion that this deterioration is due to the existence of these gaps; hence their inference was that if those gaps in the levees were closed the deposits formed under the influence of the crevasses would be swept away and the channel of the river correspondingly improved and deepened. Furthermore, levees were deemed essential, both for the safety of the works in the bed of the river, and to maintain the regimen at those places where it was already good. The only way to obtain uniformity of regimen, or to keep it when obtained, is to control the entire discharge of the river, which of course means the control of the floods as well as low stages. At the period of flood discharge you have an enormous volume of water, capable of almost any amount of mischief; at that period the cut-offs are formed and all sorts of accidents of that kind occur, all of which tend to upset the uniform regimen you are endeavoring to get.

From this point of view the function of the levee system may be considered as conservative; its other function confers a direct benefit. The plan of the Commission contemplated both of these functions and these three factors; that is, the channel contraction works, the revetment of the banks, and the levees on the top of the banks constitute the plan on which the Commission has worked from that day to this.

The CHAIRMAN. If you were regarding the navigation of the Mississippi River alone, and forgetting for the time being the land-owners up and down the Mississippi River, would you adopt the levee system in conjunction with the system which you did adopt at certain reaches there in order to make the river navigable?

Lieutenant-Colonel SUTER. Yes, sir.

The CHAIRMAN. Would you take both of them?

Lieutenant-Colonel SUTER. Yes, sir.

The CHAIRMAN. Then you differ from General Comstock in that respect?

Lieutenant-Colonel SUTER. Yes, sir.

The CHAIRMAN. What have you to say in relation to the assertion that the bottom of the river has been rising?

Lieutenant-Colonel SUTER. I do not think there is the slightest evidence of it.

Senator GIBSON. You have stated the plan adopted by the Commission? Will you now state the results achieved by the execution of that plan?

The CHAIRMAN. General Comstock has stated that fully.

Senator GIBSON. General Comstock has been practically in charge of it?

Lieutenant-Colonel SUTER. Yes, sir.

Senator WASHBURN. Have the plans you have carried out fully met your expectation?

Lieutenant-Colonel SUTER. They have; they have certainly met mine.

The CHAIRMAN. Your judgment is now that you would continue the same process you have been going through with since you have been on the Commission, in order to improve the navigation of the river?

Lieutenant-Colonel SUTER. Yes, sir.

The CHAIRMAN. Captain Leathers has been on the Mississippi River since 1836, and he says that the navigation of the river is not so easy to-day as it was in 1836, when he first went on.

Lieutenant-Colonel SUTER. I do not know anything about 1836. That is rather before my time.

The CHAIRMAN. Has there been any improvement in the navigation of the Mississippi since you have been on it?

Lieutenant-Colonel SUTER. There certainly has been where the Commission has been at work. That is the only thing upon which I can give you any definite evidence. I know that at Plum Point and Lake Providence, which are the only places where the Commission has done work of any consequence, the low-water depth has been more than doubled.

The CHAIRMAN. Those two reaches?

Lieutenant-Colonel SUTER. Yes, sir; over those portions of them where the work has been carried on.

The CHAIRMAN. What is your opinion of this Lake Borgne outlet?

Lieutenant-Colonel SUTER. I have not changed my opinion about it at all since the first report of the Commission was made. I think it is a perfect piece of foolishness.

The CHAIRMAN. Why?

Lieutenant-Colonel SUTER. Because, in the first place, it would do no good, and in the second place, I feel very confident that it would do a great deal of harm. In the third place, I do not think it could be maintained even if it was once opened.

Senator WASHBURN. You said it would do no good. If you relieve the river of a large amount of water it would do good at very high water, would it not?

Lieutenant-Colonel SUTER. No, sir, I do not think so. I have very great doubts about it. When it was first opened it might, but in a very few years this relief would disappear entirely. I think the flood heights above the outlet would ultimately increase.

Senator SAWYER. If you were to build a dam there when it got up to that surplus water it would not only relieve the water, but the country.

Lieutenant-Colonel SUTER. Wherever you divide the channel you must have an increased head to carry the water through the two branches. That is, the smaller river has the higher slope.

Senator SAWYER. You would not interfere with the water in the ordinary stage?

Lieutenant-Colonel SUTER. You would at high water.

Senator SAWYER. Use it as a waste way to get rid of that surplus water.

Lieutenant-Colonel SUTER. I think at that stage I would raise the levee beyond what the water would have been if the waste had not been there.

Senator SAWYER. Of course, if you did not have it so that it would wash out; if you did not get it down to solid foundation to back out the water, I do not think it would overflow when the river got to a certain size.

Senator WASHBURN. If you give a capacity of discharge of 100,000 cubic feet of water a second additional to the present capacity, I do not see how you would raise the water below.

Lieutenant-Colonel SUTER. I did not say "below;" I said "above." It has been known, ever since hydraulic laws have been formulated, that if you have a stream of a given capacity and divide it, you must have a steeper slope to carry the water off than you

had when it was one stream. That can only be done by raising the water surface above the point of division.

Senator GIBSON. That is, the velocity is checked above?

Lieutenant-Colonel SUTER. The velocity is checked by the increased resistance in the two branches, and you must have an increased head to force the water through.

Senator DOLPH. The Mississippi carries a great deal of sediment?

Lieutenant-Colonel SUTER. Yes, sir.

Senator DOLPH. I understood you to say that the process adopted for the improvement of the river is to narrow the river at its widest places by constructing dikes which will cause the shallow parts of the river on each side to fill up and narrow the channel.

Lieutenant-Colonel SUTER. Yes, sir.

Senator DOLPH. Is it possible to carry all the sediment down the whole length of the river and deposit it?

Lieutenant-Colonel SUTER. Yes, sir; I do not think it would make any difference. At present the Mississippi has to carry not only the sediment brought in from other streams, such as the Missouri, but also that from its own banks. This latter supply would be cut off if the banks were protected as contemplated in the plans of the Commission.

Senator DOLPH. Under the natural state of the river those widest places afford easy places for sediment where the velocity of the current is somewhat impeded?

Lieutenant-Colonel SUTER. At some places it deposits, and it scours out at others. I do not think there is much permanent deposition.

Senator CULLOM. Along the line of the river?

Lieutenant-Colonel SUTER. Yes, sir.

Senator DOLPH. Is there much sediment carried out when there are breaks?

Lieutenant-Colonel SUTER. Very little. You see the heavy sediment is near the bottom.

Senator GIBSON. What is the depth of the sedimentary stream near the bottom of the river?

Lieutenant-Colonel SUTER. I do not know. I only know that the sediment increases as you go down. There is no way in which it can possibly be ascertained how deep down the movement of sediment actually goes on. There is, however, very good reason for believing that a considerable portion of the bed of the river is in motion all the time.

Senator DOLPH. If your plan is successful in narrowing the river and raising its banks, it will remove the sediment and cause it to go through the river into the Gulf?

Lieutenant-Colonel SUTER. Yes, sir,

Senator DOLPH. If it is not sufficient to carry the sediment to the Gulf, it must be deposited then into the channel of the river and have a tendency to fill up the bed of the river?

Lieutenant-Colonel SUTER. If the current were not sufficiently strong to carry it forward I think it would, but this is not likely to be the case.

Senator WASHBURN. According to your theory it would be desirable to close the Atchafalaya outlet, would it not?

Lieutenant-Colonel SUTER. As an outlet, yes. That is to prevent the Mississippi from going into it.

Senator WASHBURN. That would raise the water above it.

Lieutenant-Colonel SUTER. I do not think it would do so permanently, although that would probably be the first effect.

Senator WASHBURN. I understood General Comstock to state that he thought it was well to maintain the Atchafalaya outlet.

Lieutenant-Colonel SUTER. That is his opinion, not mine.

The CHAIRMAN. You take a cross-section of the river 1,000 feet wide and 15 feet deep; have you any opinion what the weight of that cross-section would be a foot wide?

Lieutenant-Colonel SUTER. I do not think I understand your question.

The CHAIRMAN. Suppose the whole weight of water is so much as a square inch or a square foot, and the whole weight of that water is pressing down over the whole cross-section—

Lieutenant-Colonel SUTER. The depth of water of course will determine the pressure.

The CHAIRMAN. It must be enormous in a river a mile wide and 20 feet deep.

Lieutenant-Colonel SUTER. The pressure at any point varies according to the depth of the water. If the water is 15 feet deep there will be about 900 pounds pressure on each square foot of the bottom.

The CHAIRMAN. Of course the weight is downward?

Lieutenant-Colonel SUTER. Yes, sir.

The CHAIRMAN. With that enormous pressure downward on the bottom of this river, and the current going a mile an hour, which is acting on the bottom all the time, it will act as a scraper and take the sediment along with it?

Lieutenant-Colonel SUTER. The movement of the bottom depends entirely on the velocity of the current.

The CHAIRMAN. A slow current would move it just as a swift one; not so rapidly, but to the same depth?

Lieutenant-Colonel SUTER. That depends upon the weight of the material on the bottom. Very light material will be moved by

a current of small velocity. If you have coarse sand or gravel it takes a very much stronger current to move it.

Senator GIBSON. You made observations on the river some time ago, I think, to ascertain the velocity of the current when the river was at its highest stages and yet held within its banks. You determined that the flood, when held in the banks of the river, would take just ten days to go from Cairo to New Orleans.

Lieutenant-Colonel SUTER. Some such figure as that. I do not remember exactly. The general idea was that where crevasses took place the velocity was checked and the movement of the flood wave was retarded.

Senator GIBSON. You determined from your observation that it took just ten days for a flood contained within the river to go from Cairo to the Gulf, and that when it passed over the banks of the river it took a hundred days.

Lieutenant-Colonel SUTER. It took a very much longer period than when inside its banks.

Senator GIBSON. Does not that involve the whole question of the Mississippi River?

Lieutenant-Colonel SUTER. Very largely.

Senator GIBSON. With regard to the question of passing flood waters off, if those breaks in the levees had not occurred there is every reason to suppose that the velocity would have been obtained and the whole water would have passed off at a much lower level.

Lieutenant-Colonel SUTER. This retardation of velocity has a tendency to increase the flood height. The water behind keeps piling up on that in front until you get 4 or 5 feet of abnormal elevation.

Senator GIBSON. Have you ever looked at the tables showing the discharge of water at Columbus and Carrollton and possibly at some other points furnished by Humphreys and Abbot?

Lieutenant-Colonel SUTER. I have seen them.

Senator GIBSON. They report that when the river is at a depth of 86 feet at Carrollton and it should rise only 6 feet more, which would make it 92 $\frac{6}{10}$ feet, that the volume of discharge of the river is doubled.

Lieutenant-Colonel SUTER. I think our observations show fully that much if not more.

Senator GIBSON. Now, then, by confining the water to the channel of the river by levees so that at that point only 6 feet of water should be contained in the levees—the levees should be built so as to hold this amount of water in the river—this amount of water in the river would be the equivalent to making another Mississippi River on the top of the river when it is 86 feet deep.

Lieutenant-Colonel SUTER. Something like that.

Senator GIBSON. Eighty-six and six-tenths feet deep.

Lieutenant-Colonel SUTER. That would be the case at New Orleans.

Senator GIBSON. That shows, therefore, that it is a question of velocity.

Lieutenant-Colonel SUTER. I think it is entirely a question of velocity. If you can make that water run faster you can safely pass off the largest flood that ever came into the river. Anything that tends to retard velocity tends to increase the height of the water surface.

Senator GIBSON. If that is the law of the river, you take the flood when it reaches Cairo, and instead of being confined in the river and passing on to the Gulf at the rapid rate of ten days, therefore diminishing the surface of the river, it fills the St. Francis Basin, does it not?

Lieutenant-Colonel SUTER. Yes, sir.

Senator GIBSON. There is a vast accumulation of water stored there, the velocity is interrupted, retarded, the height increases by this retardation of the river itself; then with the accumulated force of this vast amount of water accumulated in the basin of the St. Francis, that accumulation is precipitated on the river below, is it not?

Lieutenant-Colonel SUTER. Yes, sir; it comes out and returns to the Mississippi while it is still high.

Senator GIBSON. That is a flood on top of a flood caused by this retardation, because the law of velocity has been suspended. It is like accumulating a great body of troops to make an assault. It increases the height of the river at the point of attack on the levees below. Now, is not that the reason why the levees gave away on the upper line of the Mississippi, in the State of Mississippi, and on the lower line of the Arkansas, this concentration which was furnished by the St. Francis Basin?

Lieutenant-Colonel SUTER. I have not yet had an opportunity to sufficiently study the records of this flood; we have not got them yet and I do not feel able to discuss the subject intelligently. There are gentlemen present who are more familiar with the facts who can doubtless answer that question.

Senator GIBSON. I am not asking you with reference to the facts, but with reference to the theory.

Lieutenant-Colonel SUTER. I was going to say that according to my notion—I may be mistaken—I think that the great heights that were obtained in the lower part of the river were due to the southern tributaries. They had most unusual floods. What you were saying, however, is undoubtedly true. I think there is very little question that the great flood heights obtained at Helena are higher than they would have been if the water had all passed down the main channel.

I think the water that is drawn off into the St. Francis Basin and then returned at Helena will give a greater height at Helena than if that water were to pass down the main channel. The same phenomenon occurs at Vicksburg and possibly other places.

Senator GIBSON. The same at Red River at the foot of Tensas Basin?

Lieutenant-Colonel SUTER. Exactly.

Senator GIBSON. I believe you and General Comstock are not entirely agreed on all matters pertaining to the conduct of the work of the Mississippi River, as I understand you. Does that disagreement involve you in any way in carrying on the work with the execution of which you have been charged?

Lieutenant-Colonel SUTER. No, sir.

Senator CULLOM. You are acting under the statute without reference to what you believe?

Senator GIBSON. You all agree on the plan?

Lieutenant-Colonel SUTER. The Commission does.

Senator CULLOM. You mean a majority of the Commission?

Senator GIBSON. I understand that General Comstock approved the plans, but he did not do so for the same purpose.

The CHAIRMAN. Not for navigation purposes? He does not approve the plans for navigation purposes?

Senator GIBSON. He said that it would cost \$10,000,000 less to use the levees in connection with the improvement of the river for navigation purposes than it would cost without them.

The CHAIRMAN. He thought it might cost \$10,000,000 less.

At 12 o'clock m. the committee took a recess until 2 o'clock p. m.

At the expiration of the recess the committee resumed its session.

STATEMENT OF LIEUT.-COL. CHARLES R. SUTER

CONTINUED

The CHAIRMAN. Captain Condon has handed me some questions which he desires should be propounded to you. Would you levee, dyke, spur-dam, etc., the upper end of a sediment-bearing stream before you would improve the lower end of such stream?

Lieutenant-Colonel SUTER. I do not know what is meant by "improve" in that question. There are different ways of improvement.

The CHAIRMAN. Well, what do you say in answer to his question?

Lieutenant-Colonel SUTER. Unless I understand it better than I now do, I can hardly answer it.

The CHAIRMAN. Then take it the other way. Would you improve the upper end of a sediment-bearing stream before you did the lower?

Lieutenant-Colonel SUTER. If it needed it more; yes.

The CHAIRMAN. Will water flow down an angle or incline of two inches to the mile faster than it will flow down an incline of one inch to the mile?

Lieutenant-Colonel SUTER. That depends on the depth.

The CHAIRMAN. Is the fall greater per mile at Cairo than at New Orleans?

Lieutenant-Colonel SUTER. Yes, sir.

The CHAIRMAN. Is the current greater at Cairo than at New Orleans?

Lieutenant-Colonel SUTER. I think the difference is very slight. I do not remember the exact figures.

The CHAIRMAN. Does not the greater current above bring the mud down faster than the slower current at the lower end can discharge it?

Lieutenant-Colonel SUTER. I do not think there is a slower current at the lower end.

The CHAIRMAN. Suppose the current was faster above.

Lieutenant-Colonel SUTER. Then it would, undoubtedly; but I do not think such is the case.

The CHAIRMAN. If you build levees higher at the lower end than at the upper end, does that increase or decrease the angle of fall?

Lieutenant-Colonel SUTER. It most likely would have nothing to do with it.

The CHAIRMAN. It is claimed that the inflow of water is 2,100,000 cubic feet per second and that the overflow of water at the mouths of the Mississippi is 1,100,000 cubic feet per second; and if this be true, will you explain how you would prevent overflows?

Lieutenant-Colonel SUTER. By raising the levees sufficiently.

The CHAIRMAN. Is the South Pass in any sense an outlet of the Mississippi?

Lieutenant-Colonel SUTER. It is one of the mouths. Any outlet can be considered as a mouth. I suppose the mouth could be considered an outlet.

The CHAIRMAN. Are the mouths of the Mississippi in any sense outlets?

Lieutenant-Colonel SUTER. I think they are.

The CHAIRMAN. If you wanted to get the flood water of the Mississippi into the Gulf of Mexico quicker than it would now flow through the present mouths, would you close up all of the present mouths or would you open more outlets?

Lieutenant-Colonel SUTER. I certainly should not open more. Whether I would close the others or not is a question I have never particularly considered. Our jurisdiction stops at the Head of the Passes, so that I have not considered it.

The CHAIRMAN. If it were possible to make the Lake Borgne

outlet wide enough and deep enough to lower the flood line of the Mississippi River at that place down to Gulf level, would that enormous outflow of flood water increase or decrease the current of the Mississippi River?

Lieutenant-Colonel SUTER. What do you mean, decrease it where; above or below?

The CHAIRMAN. The question does not state which.

Lieutenant-Colonel SUTER. That is a very important question.

The CHAIRMAN. Take it both ways.

Lieutenant-Colonel SUTER. It would certainly decrease it below.

The CHAIRMAN. What would be the effect above?

Lieutenant-Colonel SUTER. First a great increase; eventually I do not think there would be any.

The CHAIRMAN. Have you stated what your opinion is of what is called the outlet system?

Lieutenant-Colonel SUTER. Yes, sir; I believe I have.

Senator GIBSON. Have you stated the result of the improvement at Plum Point and Lake Providence Reach in relation to navigation?

Lieutenant-Colonel SUTER. I think not.

Senator GIBSON. What have been the results?

Lieutenant-Colonel SUTER. The low-water depths have been about doubled.

Senator GIBSON. Do you know what effect the levees have had on the navigation anywhere?

Lieutenant-Colonel SUTER. Yes, sir; I think they have had a very decided effect at Lake Providence, and also to a certain extent at Plum Point. At Plum Point the levees have been constructed by the Commission purely and entirely to improve navigation. They are local levees, on both banks of the river, and the effects have been very marked.

Senator GIBSON. You stated a moment ago in reply to a question by the chairman that if you were improving the Mississippi River, even if it were running through a wilderness, if the country through which it ran was not peopled, you would still build levees on the banks.

Lieutenant-Colonel SUTER. Yes, sir.

Senator GIBSON. Why do you hold that opinion?

Lieutenant-Colonel SUTER. Because I consider that the improvement of the stream for navigable purposes; without it is impossible.

The CHAIRMAN. Why?

Lieutenant-Colonel SUTER. I think you have got to retain control over the whole volume of water. The discharge which passes within the banks is less than half of the flood discharge of the river, and the low-water discharge is only about one-tenth of that which passes within the banks, about one-twentieth of the total discharge,

and any works that you can put in to control the low-water flow on a stream like the Mississippi are liable to be utterly destroyed and rendered nugatory by this vastly larger volume of water which passes down the river during flood stages. At this season of the year the cut-offs occur, which will upset any plan of improvement, because they change entirely the regimen of the river, its course, its slopes, and everything about it.

Again, the water being over the works and everything else, has a chance to develop new channels precisely where you do not want them to occur. A still further effect is produced where the levees are down; the water that goes over the banks keeps going out and coming back again. Whenever it makes its appearance in the river it acts like a tributary. It produces entirely new phases, just as any tributary will. Sometimes it entirely reverses the conditions of flow. The influence that levees exert under these heads I believe I have stated as conservative. They prevent the river from doing damage to the works we put in to improve the low-water discharge of the stream.

The CHAIRMAN. If there was no question about protecting the land, and you were simply improving the Mississippi River for navigation, would you have built the levees that are now built?

Lieutenant-Colonel SUTER. Yes, sir.

The CHAIRMAN. You say you would?

Lieutenant-Colonel SUTER. Yes, sir.

The CHAIRMAN. So that, regardless of the question of the landowners, you say that this Commission has done none too much toward levee building?

Lieutenant-Colonel SUTER. That is my opinion.

The CHAIRMAN. Do you not think the people whose lands are preserved by these levees should pay a part of the expenses of constructing them?

Lieutenant-Colonel SUTER. That is hardly an engineering question. I think, however, the same question might be asked with regard to other improvements. For instance, one of the most important features of the work of the Commission is the protection of the banks from caving. In doing that we do it entirely in the interest of navigation, but it does at the same time prevent many a man's plantation from caving into the river.

The CHAIRMAN. In other words, you think the levee is a part of your system as well as the jetties?

Lieutenant-Colonel SUTER. Yes, sir.

The CHAIRMAN. You mean to say that these dikes and levees are necessary to preserve the channel of the river itself?

Lieutenant-Colonel SUTER. Yes, sir.

The CHAIRMAN. The permanency of the channel?

Lieutenant-Colonel SUTER. Yes, sir; that is my view.

The CHAIRMAN. How long did you say you had been on the river?

Lieutenant-Colonel SUTER. Since 1866.

STATEMENT OF CAPT. SMITH S. LEACH.

Capt. SMITH S. LEACH, United States Engineers, in charge of first and second districts of the Mississippi River, appeared before the committee.

The CHAIRMAN. How long an acquaintance have you had with the Mississippi River?

Captain LEACH. Since 1878.

The CHAIRMAN. Are you a member of the Commission?

Captain LEACH. Yes, sir; I am a subordinate officer of the Commission.

The CHAIRMAN. Where are you located?

Captain LEACH. At Memphis.

The CHAIRMAN. State what your experience with the river has been.

Captain LEACH. In the summer of 1878 the board of engineers was organized which was referred to here by General Comstock and others. I was then second lieutenant of engineers and was assigned to duty as recorder of that board. That board undertook extensive surveys, examinations, hydrometric measurements, etc. The field work of a large part and the computations of all of these were placed in my immediate charge. I began from that time to study this question from the original data and measurements made upon the stream itself, and I have done nothing else professionally from that day to this.

The CHAIRMAN. Have you observed the overflows of the river?

Captain LEACH. Repeatedly. I have been over the river in its whole length and at almost every stage of water.

The CHAIRMAN. State to the committee as briefly as you can your idea of the improvement of the Mississippi River for navigation.

Captain LEACH. To start with what should not be done, I would mention the project of taking off any portion of the water of the natural discharge of the river at any stage whatever or for any purpose, or at any point. The salient point in connection with that topic is, first, the question of the effect upon the channel of the river above and below resulting from taking off such water under such circumstances. I have here a complete map of the Delta of the Mississippi showing its approaches to the Gulf. I may state a fact, which I do not think will be denied by any one, that this single-trunk channel as it approaches the Head of the Passes is one of the finest navigable flowing streams on the face of the earth. It is of reasonable width, very deep, and has at all times a regular and moderate current. At a point here [indicating on map] it is divided into three

principal branches. Each one of those branches is narrower and shallower and more irregular in its regimen than is the main stream. This is the Head of the Passes [indicating on map].

At this point where this main stream is divided into three branches the phenomenon is presented of a large and deep and good channel being transformed into three narrow and shallow and poor channels. A great deal of talk has been heard about the difficulty that Captain Eads had in removing the bar at the mouth of South Pass bar. If he were here to-day he would confess a much more serious difficulty in dealing with the shoal water at the head of that pass. This is the bar that gave him the real difficulty [indicating on map]. This is the bar at the Head of the Passes at the point of diffusion, at this point division of the main stream. It was to get a greater depth over this bar at the head of South Pass that he laid a sill over the other two passes, and constructed the funnel-shaped prolongations of the natural banks of this pass in order to augment the flow of water through there.

We have these three passes, each having a bar at each end, and each being 30 feet average depth between the bars in its original and natural condition as against 125 or 130 feet depth of the main stream. Here is the South Pass [indicating on map]. This is the one that has the great depth. This is the one that carries from 26 to 30 feet. This Southwest Pass carries less than that, perhaps 16 feet.

Now, the point I make is this: This phenomenon occurs here [indicating on map]. It occurs at the corresponding point on every known alluvial sedimentary stream on the face of the earth that branches into a delta formation.

Now, if the degradation of these subsidiary channels occurs here when the stream divides into three parts, why will it not occur at Lake Borgne if you there divide it into two? The fact can be explained on no other hypothesis than that in division there is weakness, a proverb more familiar in the inverse terms "In union there is strength." I never heard any other advanced for it, and its converse, which the outlet theory demands for its support, is not only absurd on its face, but contradicts every fact of the river's life which has come to my knowledge. Anything further on the subject of outlets is only an elaboration of that general statement. To substantiate that, if proof should be necessary, there are frequent observations in the bed of the river itself. These consist of a large number of exact measurements, as precise and accurate for that purpose as would be any measurement that could be made of the length of this Capitol building. We have not guessed at this thing; we have measured it, and we had no theory to establish when we made the measurement, but we made the measurement for the purpose of finding out the theory.

The measurements have shown conclusively in repeated in-

stances that when a crevasse occurs the channel for a few miles immediately below becomes distinctly smaller. When that crevasse is closed measurements made before and after the closure have shown that this loss in the area of the channel is recovered. When a crevasse is closed and immediately after that closure—let me change the form of that statement—when a crevasse opens and immediately after that opening by exact measurement there is found to be a deterioration of the channel of about 12 per cent of its area, and again when this same crevasse is closed after the next succeeding flood there is found to be a recovery of this 12 per cent lost, I do not think any other hypothesis will explain it.

Second in importance will be the deterioration of the navigable depth in this channel, which is now an extraordinarily good one, and which can be maintained there, as the experience of the last ten years has shown, at a very trifling expense. If that channel were injured and deteriorated by the natural and inevitable result of taking off a large portion of the flood discharge at a point higher up the river, you would then, instead of having little or no expense to keep it open, have an enormous annual expense, and even then the condition of the channel would be so precarious that the effect on commerce would be very detrimental. Ships will go to a port where they know they will find 26 feet of water, without doubt, more readily than they would go to a port where they were promised 30 feet and might find but 20 feet. A reliable 26-foot channel is better than a precarious 30-foot channel.

The CHAIRMAN. You are familiar with the methods of the Mississippi Commission as to improvements?

Captain LEACH. Will you bear with me a little further on this topic?

The CHAIRMAN. Yes, sir.

Captain LEACH. The question has been discussed over and over again as regards the elevation of the bed of the river as the result of the construction of levees, and also as to the deterioration of the channel below the outlet. I know of no engineering authority that can be quoted in support of this view, except by garbling, and as you have had a little garbling already before you I would like to read some full and complete extracts. I have before me the report of Colonel Ellet. I would like to read a few extracts from it; it will take but a moment. I will read the introduction pretty much *in extenso*.

The CHAIRMAN. When was that report made?

Captain LEACH. Eighteen hundred and fifty. It is a report and the only one I know of where an engineer of any standing has deliberately and definitely proposed to make a certain definite outlet.

"In this paper the causes of the more frequent and more extensive overflows of the Delta of the Mississippi in recent than in

former times are considered, and plans suggested for the mitigation of the evil.

"The greater frequency and more alarming character of the floods are attributed—

"Primarily, to the extension of cultivation throughout the Mississippi Valley, by which the evaporation is thought to be in the aggregate diminished, the drainage obviously increased, and the floods hurried forward more rapidly into the country below.

"Secondly, to the extension of the levees along the borders of the Mississippi, and of its tributaries and outlets, by means of which the water that was formerly allowed to spread over many thousand square miles of lowlands is becoming more and more confined to the immediate channel of the river, and is, therefore, compelled to rise higher and flow faster, until, under the increased power of the current, it may have time to excavate a wider and deeper trench to give vent to the increased volume which it conveys.

"Thirdly, to cut-offs, natural and artificial, by which the distance traversed by the stream is shortened, its slope and velocity increased, and the water consequently brought down more rapidly from the country above, and precipitated more rapidly upon the country below.

"Fourthly, to the gradual progress of the Delta into the sea, by which the course of the river at its embouchure is lengthened, the slope and velocity there are diminished and the water consequently thrown back upon the lands above.

"It is shown that each of these causes is likely to be progressive, and that the future floods throughout the length and breadth of the Delta and along the great streams tributary to the Mississippi are destined to rise higher and higher as society spreads over the upper States, as population adjacent the river increases, and the inundated lowlands appreciate in value.

"For the prevention of the increasing dangers growing out of these several co-operative causes six distinct plans are discussed and advocated:

"First. Better, higher, and stronger levees in lower Louisiana, and more efficient surveillance—a local measure, but one requiring State legislation and official execution and discipline.

"Second. The prevention of additional cut-offs; a restraint which may call for national legislation, or possibly judicial interference to prohibit the States and individuals above from deluging the country below.

"Third. The formation of an outlet of the greatest attainable capacity from the Mississippi to the head of Lake Borgne, with a view, if possible, to convert it ultimately into the main channel of the river.

"Fourth. The enlargement of the Bayou Plaquemine, for the purpose of giving relief to that part of the coast which now suffers

most from the floods, viz: to the borders of the Mississippi from above Baton Rouge to New Orleans.

"Fifth. The enlargement of the channel of the Atchafalaya for the purpose of extending relief higher up the coast, and conveying to the sea, by an independent passage, the discharge from Red River and the Washita.

"Sixth. The creation of great artificial reservoirs, and the increase of the capacity of the lakes on the distant tributaries, by placing dams across their outlets with apertures sufficient for their uniform discharge, so as to retain a portion of the water above until the floods have subsided below. It is proposed by this process to compensate, in some degree, for the loss of those natural reservoirs which have been and are yet to be destroyed by the levees, and, at the same time and by the same expedient, improve the navigation of all the great tributaries of the Mississippi, while affording relief to the suffering and injured population of the Delta."

Now I read again from part 2 of Prolongation of the Delta:

"It is a popular belief that the bed of the Mississippi is gradually *rising*, and to that assumed cause is not unfrequently attributed the constantly increasing height required for the protecting levees. But this belief can be traced to no better evidence than the fact that certain points which formerly exhibited deep soundings have subsequently become shallower, a circumstance which is attributable altogether to the shifting nature of the shore and bottom of the river. As consequences of the changing and movable character of the soil through which the Mississippi flows, shores which are at one period curved subsequently become salient; banks that at one time wash and cave in, at a later date fill up; places which during one period are gradually growing deeper, at another become less deep and to the sounding line indicate an elevation of the bottom. There is, in fact, no evidence of any change in the general level of the river's bed beyond what may be inferred from the evident prolongation of the Delta, the lengthening out of the course of the stream, and the consequent diminution of the plane of descent. But this elevation of the bed is not indicated by any increased depth of the stream, though it must of necessity occasion a corresponding elevation of the surface. Any increase in the height of the floods, produced by a given body of water discharged in a given time, beyond what may be justly attributed to this extension of the Delta, must, therefore, be sought in other adequate causes.

"The idea which has acquired a certain hold upon public opinion that an appreciable elevation of the bed of the Mississippi has been produced and is still going forward in consequence of the extension of the levees, has no foundation in experience or philosophical deduction. The extension of the levees, it will be hereafter shown, exercises great influence upon the height of the floods, but not, as is supposed, by raising the bed of the river. It is true that by the increased

transporting power which the levees give to the river and by their prevention of lateral deposits the Mississippi is enabled to convey greater deposits into the Gulf, and thus, in some slight degree, accelerate the formation of land opposite its mouths. To this amount and no further the extension of the levees may promote the elevation of the river's bed, but this is not an appreciable quantity.

"It is customary to point to the Po in evidence of the effect of embanking the coasts of streams in producing an elevation of the bed of the river. And it is assumed that because the bottom of the Po and of all rivers that empty into the Adriatic is to be found in the great quantity of earthy matter which they transport to the sea, and the shallowness of the gulf into which this material is conveyed, this deposit in the course of twenty centuries has produced a prolongation of the delta of the Po estimated at about 25 miles, and has converted cities which at the commencement of the Christian era were respectable seaports into inland towns, at this day 20 miles from the seashore."

Senator GIBSON. You mean to say that more modern investigations have shown that the Po did not rise?

Captain LEACH. At the time that Colonel Ellet was writing in the United States, Lombardini had written in Italy a complete refutation of De Prony's conclusions as to the bed of the Po rising. Lombardini's researches were probably not known to Colonel Ellet, who, feeling himself obliged to accept the current belief that the bed of the Po had risen, is so confident that levees had and could have nothing to do with it that he takes pains to bring forward another explanation.

Cut-offs are mentioned in this outlet scheme as being in the dim future desirable to be done.

"Among the causes of inundations that have recently produced so much loss and distress on the lower Mississippi, in the opinion of the writer, must be enumerated the cut-offs which have been made at and below the mouth of Red River. It is true that men of science have denied, and do still contest, this point. But the opinion here entertained rests on what are deemed to be the natural laws of the flow of the river, and, moreover, on indisputable results. The theory which is entertained by many intelligent persons, that by shortening the channel and cutting off the bends of the river the velocity of the current will be increased, the channel scoured out wider and deeper, the floods conveyed more rapidly to the sea, and the surface therefore reduced, is all perfectly true, excepting the practical conclusion."

The following extract is read to show that Colonel Ellet's mind dwelt especially upon an outlet as a means of taking off water that could not be controlled in any other way:

"But there is another ground for the practical conclusion that extensive outlets may be opened without a shadow of fear for the preservation of the channel below. The Mississippi and its natural

outlets are now greatly overburdened in times of extreme high water and are unable to vent the volume which is poured into them by the distant tributaries as fast as it is brought down. This excess of water finds new outlets by overflowing the natural banks or through crevasses in the artificial levees. Outlets, then, acting only as high-water vents, through which this surplus may be let off, can not possibly diminish the actual area of the river's section below, for such outlets will discharge water which does not pass through the channel at all.

* * * * *

"Again, it has been seen that the volume discharged by the floods of the lower Mississippi is annually increasing, in consequence of the extension of levees above. In opening outlets below Red River sufficient to give passage to this increased supply, as it comes, we can not possibly impair the efficiency of the present channel, for this increased discharge has had no part in the creation or maintenance of the present channel."

That passage bears on the same point.

"A word may be added in allusion to the fear often expressed that the new outlets, which it is proposed to open at points where the route which the waters will follow to the sea will be shortened, may ultimately become so enlarged as to absorb the Mississippi itself, and thus leave the city of New Orleans on some secondary bayou.

"The reply to this apprehension is the fact already stated, that the water passing through such vents is never known to cut out or deepen its channels without assistance. The bayous which still lead from the river into the adjoining lakes and swamps have been in activity during thousands of years, and do not seem to have gained the least on the Mississippi, while the whole Delta shows evidence of ancient outlets which have been filled up by deposits and now no longer act in relieving the discharge of the river.

* * * * *

"Indeed, the writer is not in possession of any fact which goes to show that any outlet can be made from the Mississippi, above New Orleans, which, left to itself, will become larger and ultimately excavate a new channel into the Gulf. If we could calculate with confidence on such a result, the problem of protecting the country below Red River would be relieved of all its difficulties at once, for we might then open an outlet into Lake Borgne, and, turning the Mississippi into that arm of the Gulf, transfer its embouchure to the deep water south of Ship Island, and thus promptly reduce its high-water surface some 6 feet at New Orleans. But, unfortunately, the water can not open the way without assistance, and the new channel will not be produced without other aid."

Senator WASHBURN. You infer that he favors that if it could be done?

Captain LEACH. His conclusion appears very plain. He is in favor of a limited high-water outlet.

He goes on to say:

"These objections to the use of outlets, to a limited extent, are not tenable. It is, therefore, proposed to resort to high-water vents so far as is necessary to obtain prompt though limited relief from pressing distress and impending calamity, but not to rely on this expedient exclusively, or even to look to it for full protection or permanent security.

"The object of this examination is not considered to be merely the protection of the country below Red River from the difficulties against which the population there is now struggling, but to embrace the whole area of the Delta, and to do the work by some plan that will not be incompatible with the intention of Congress, as it is manifested in recent legislation, to reclaim all the lands in that vast area which are subject to inundation. These great purposes will be aided but not accomplished by outlets which, therefore, are now only recommended for local relief and limited application."

* * * * *

After describing outlets in full he says:

"But, in addition to all this, the protection of lower Louisiana will require other expedients. For this State, indeed, there is no alternative. She can not wait for Congress to discuss, doubt, survey, and appropriate. She can not wait for the slow machinery of legislation. She must build levees without hesitation or delay, or see her fields annually swept by the floods.

* * * * *

"But, while recommending these prompt and vigorous measures, it is the duty of the writer to express his conviction that, after all these means of relief, carried as far as prudence and proper regard to economy and the interests upon which this excess of water will be turned, have been exhausted, they will be found insufficient to secure even the State of Louisiana against the floods which, at no distant day, will be poured down the Mississippi, while the great area subject to inundation in the States of Arkansas and Mississippi can receive no sensible relief from any of these expedients but that of levees. To secure the whole Delta it will be necessary to commence promptly and press vigorously the great work of retaining the waters in the mountains."

This is the reservoir idea. There are more of these extracts than I thought there were. I think I have read all that are really important, and I hope enough to give you the opinion that the idea, the tenor of this report, as previously put before you, is erroneous. I hope it was unintentionally done, but I can scarcely believe it.

Now, if this report is read, the impression is obtained that Colonel Ellet was in apprehension of a perfectly appalling increase of floods in the Mississippi. He goes so far as to say that he thinks

in no long period of time the increase of floods due to the progress of deforesting and the extension of cultivation and drainage, together with the building of levees, will cause an increase in the height of the floods of 18 feet at Red River. Since that time deforesting has gone on for forty years, and I believe now is about at a maximum. I think that tree planting is keeping pace with deforesting. Cultivation and drainage have gone on in the Mississippi Valley, and have gotten nearly as far as they are going, and we have had no such elevation floods. We have as yet had no floods that could not be restrained with levees of moderate heights.

Such floods as Colonel Ellet anticipated have never been realized; never will be; never can be. The whole tenor of his report shows very plainly that he was forced to accept the outlet theory against his deeper conviction, simply because he thought that no levees which could possibly be built would restrain the floods which he expected in the future.

His idea was that the extension of the levees would hurry forward the discharge from above. The elevation of the flood line would begin at Cairo and increase until it reached this figure, 18 feet at Red River.

Subsequent experience has shown that these apprehensions were entirely unfounded. We get a good illustration of that from the Po at Ferrara, which occupies a position on the Po about the same as that of Vicksburg or Natchez on the Mississippi. The super-elevation of the flood surface within the history of the Po for several hundred years, due to the extension of levees and other causes, is about 3 feet. It is reasonable to suppose that the super-elevation caused by the hastening forward of the discharge of the floods will bear some relation to the slope of the river and its size. In slope the Po leaves off at the sea about where the Mississippi begins at Cairo. If the hastening forward of the flood on the Po, with a slope of from 30 inches per mile at its headwaters to 5 at the sea, results in an increased height of 3 feet at Ferrara, we may reasonably expect that the super-elevation of floods due to the same cause on the Mississippi will be less in amount—less than 3 feet, since the greatest slope of the latter stream is but little in excess of the least slope of the former.

The CHAIRMAN. In how long a period?

Captain LEACH. Forever; the causes of increase must culminate at some time.

The CHAIRMAN. Captain Leathers says the bottom of the river has risen 7 or 8 feet now.

Captain LEACH. I know he does.

The CHAIRMAN. What do you say about that?

Captain LEACH. The gauge records show that the absolute elevation of the low-water surface is about, as nearly as can be figured, where it always has been at various points. Captain

Leathers runs his boat through low water, at about 7 feet depth, and if the bottom has risen 7 feet, the surface remaining stationary, he would have no water to run his boat through. He would have to run it on wheels. The low-water surface has not risen. We have unquestionable evidence as to that. We have measurements just as good as any man can make. We have records that have been made at various places by a great many different people, so that there could be no collusion about it, no mistake about it. They agree perfectly; they are consistent with each other. Their reports are that the low-water surface is exactly where it was for about the same volume of discharge. The records at Natchez go back to the beginning of this century.

The CHAIRMAN. Captain Leathers says the bottom of the river has risen at Memphis.

Captain LEACH. I do not know what Captain Leathers has stated. The records at Memphis show nothing of the kind.

The CHAIRMAN. Now, captain, the committee will be glad to have you give your views as to the plans the Commission have adopted to improve the river.

Captain LEACH. As to the improvement of the river, I do not know that I have anything new to add over and above what has been stated. The plan of the Commission has been outlined. The degree of success that has been attained has been stated. In all those points I can do no better than to say that I fully concur.

The CHAIRMAN. General Comstock says that in his opinion levees are not necessary to improve the navigation of the Mississippi River, while Major Suter says that in his opinion the levees are essential. What is your opinion about that?

Captain LEACH. My opinion is that they are absolutely essential; that there are certain well-defined possibilities to the improvement of the Mississippi River. There are certain natural conditions present which by proper scientific treatment can be made to produce a stream of a certain degree of navigability. It has its ultimate possibilities. With levees, that possibility can be attained; without levees it can not. Without levees a stream can be improved; with levees it can be improved much more. That is my idea of the river with and without the levees.

The CHAIRMAN. General Comstock, what is your view—is it best in making an appropriation of two or three millions for the improvement of the Mississippi River to direct the expenditure of money at particular points?

General COMSTOCK. If the money is intended to be spent in protecting towns and cities and villages along the river, that object will be attained by that process, but probably there will be very little left for the improvement of the river generally.

The CHAIRMAN. Has not the Commission, so far as navigation

and its interests are concerned, been very much crippled by the action of Congress in thus disposing of its appropriations?

General COMSTOCK. I think so in some degree, because I think Congress would have given us probably a large amount for the general improvement of the river if they had not made specific appropriations. For instance, in the last bill there was an appropriation of fifty or sixty thousand dollars for Columbus, some for Greenville, and so on down. Those were all places where money would come out of what we otherwise would have had to use for the general improvement of the river.

The CHAIRMAN. Major Suter, I want to ask you the same question.

Major SUTER. My opinion is about the same as General Comstock's.

Captain LEACH. That is a question rather higher in the horizon than I have ever been called upon to consider. I am only a subordinate. I have tried to execute the plans of the Commission and to carry out the will of Congress expressed in the law, and in regard to probable or possible improvement in the method of making appropriations I do not know that I have any opinion to express.

Senator WASHBURN. I would like to ask a question. Suppose Congress should appropriate two and a half or three million dollars for the improvement of the lower Mississippi without restriction, how would it be expended by the Mississippi River Commission?

General COMSTOCK. I can answer that. I do not think it would be an unjust distribution to make the distribution we have made heretofore, two-thirds for the improvement of the river and one-third for levees.

Senator GIBSON. Captain Leach, you are not a member of the Mississippi River Commission?

Captain LEACH. No, sir.

Senator GIBSON. I suppose shortly after you graduated from West Point you were assigned to the Mississippi River Commission?

Captain LEACH. I graduated in 1875, and in 1879 I was assigned as secretary of the Commission.

Senator GIBSON. Did you have any preconceived notions as to how the river should be treated?

Captain LEACH. Not at all.

Senator GIBSON. Your opinion is based upon your experience and observation on the river?

Captain LEACH. Entirely so.

Senator GIBSON. Are you a native or a resident of the Valley of the Mississippi?

Captain LEACH. No, sir; I am a native of Indiana.

Senator WASHBURN. You do not agree with Colonel Ellet in the opinion that these outlets, what you call high-water outlets, are desirable?

Captain LEACH. No, sir.

Senator WASHBURN. Under no condition of things?

Captain LEACH. No, sir; because the conditions under which Colonel Ellet arrived at the conclusion he did were predictions for the future. We are now in a good part of that future. We see that those predictions will not be realized.

Senator WASHBURN. Why should not the same principle apply? We have had very high water this year, perhaps not as high as he contemplated, but certainly very high. Why should not the same principle apply in the very high water we have had this year as he contemplated?

Captain LEACH. The best method of controlling a flood is by levees. There are physical limits to the building of levees, and if a flood went so high as to exceed those limits, then it would be necessary to obtain relief. It was under such apprehension, in my opinion, that Colonel Ellet proposed an outlet.

Senator WASHBURN. Major Suter takes the position that the river with these outlets would not discharge the water as rapidly as though it were held in one channel.

Captain LEACH. I think it is fully agreed that there would be an immediate relief. The great destruction will come on the second or third generations hence, and of course if a man is under water he will get out, regardless of what is going to happen to his descendants.

Senator WASHBURN. You think that by making these outlets, take the Atchafalaya, we would afford immediate relief from the great floods?

Captain LEACH. It would afford slight local relief from the pending flood, undoubtedly.

Senator WASHBURN. In other words, it would discharge the water more rapidly than though you attempted to maintain it in one channel?

Captain LEACH. I do not know.

Senator WASHBURN. You would get rid of it?

Captain LEACH. Yes, sir; it would reduce the level slightly. Two years ago I thought myself, and stated before a committee of this Senate that I thought it possible to reduce the surface 10 feet by opening the Lake Borgne outlet. I should be compelled to divide that by 2 now—5 feet, by any possible outlet.

Senator WASHBURN. And you hold still further that the degree of elevation would decrease as the years went by?

Captain LEACH. Very much. The scope of the river to the mouth of the passes would be increased. Now, if you want to increase the inclination of a line one end of which is fixed, it can only be done by raising the other end. The Mississippi River from the Gulf to New Orleans is such a line. Its lower end is fixed at Gulf level, and if it is compelled by division to take a steeper slope,

it can only do it by raising its level at New Orleans. The divided channels must inevitably take a higher slope, and in doing so the point of their divergence must be elevated absolutely.

Senator GIBSON. And that would make a bar.

Captain LEACH. Unquestionably, and it will raise the flood line also. Nothing else you can do will elevate the flood plane so certainly. In fact, that is the one solitary thing that must give New Orleans bigger floods than ever before.

The CHAIRMAN. Captain Cowden wants me to ask you certain questions. Would you levee-dike, spur-dam, etc., the upper end of a sediment-bearing stream before you would improve the lower end of such a stream?

Captain LEACH. That would depend entirely upon the conditions. If the lower end demanded improvement in the interest of navigation and the upper end did not, I would sacrifice my theories and improve the lower end first, provided I held such theory, and on the converse, if the upper end demanded improvement and the lower end did not, I would improve the upper end. I would improve the end which first demanded it.

The CHAIRMAN. Will water flow down an angle or incline of 2 inches to the mile faster than it will flow down an incline of 1 inch to the mile?

Captain LEACH. Not necessarily. It may flow very much faster down the lower inclination.

The CHAIRMAN. The same volume and the same width?

Captain LEACH. No restrictions with regard to volume were made. I was only asked one question with regard to velocity and slope. The velocity depends, as nearly as it can be stated in brief terms, on the square root of the angle of the fall and the square root of the mean depth. To increase the mean depth will increase the velocity just as much as an equal increase of slope. The average mean velocity of high water from Cairo to New Orleans does not differ very much from 6 feet in a second; that regardless of considerable changes in slope. Repeated observations, hundreds of them, are available to show that there is a remarkable uniformity in the mean flood velocity from Cairo to the Gulf.

The CHAIRMAN. Is the fall greater at Cairo than at New Orleans?

Captain LEACH. It is.

The CHAIRMAN. Is the current greater at Cairo than at New Orleans?

Captain LEACH. A little greater at low water, but at high water it is almost the same.

The CHAIRMAN. Then does not the greater current above bring the mud down faster than the slower current at the lower end can discharge it?

Captain LEACH. There is no greater current above.

The CHAIRMAN. If you build levees higher at the lower end than at the upper end, does that increase or decrease the angle of fall?

Captain LEACH. I do not think it has any effect at all.

The CHAIRMAN. It is claimed that the inflow of water is 2,100,000 cubic feet per second, and that the outflow of water at the mouths of the Mississippi is 1,100,000 cubic feet per second, and, if this be true, how would you prevent overflows?

Captain LEACH. By one of the best-known principles of river physics; that is, that there is a very appreciable reservoir effect in the volume of the channel itself. If the water is flowing in at Cairo faster than it is flowing out at New Orleans and I am asked where the surplus goes, I am able to reply that it goes to raising the surface of that water. There are thousands of square miles of water to be raised and it rises sometimes in places as high as 2 or 3 feet a day.

The CHAIRMAN. Is the South Pass in any sense an outlet of the Mississippi?

Captain LEACH. Yes, sir.

The CHAIRMAN. Are the mouths of the Mississippi in any sense outlets?

Captain LEACH. In every sense.

The CHAIRMAN. If you wanted to get the flood water of the Mississippi into the Gulf of Mexico quicker than it would now flow through the present mouths, would you close up all of the present mouths or would you open more outlets?

Captain LEACH. I certainly should not close up all the mouths of any stream under any circumstances. I admit that I would leave at least one open.

The CHAIRMAN. Would you open any more outlets?

Captain LEACH. No, sir.

The CHAIRMAN. If it were possible to make the Lake Borgne outlet wide enough and deep enough to lower the flood line of the Mississippi River at that place down to the Gulf level, would that enormous outflow of flood water increase or decrease the current of the Mississippi River?

Captain LEACH. It would increase the current for a short distance above enormously and it would decrease the current below. In fact, if the hypothesis stated were realized, there would not be any current at all below except a little ebb and flow of the tide, and of course it would increase the current enormously above, it would aggravate the destruction of the banks, and in that way would not only make the maintenance of a levee system along there very precarious, but it would make the work of regulation of the stream very difficult.

The CHAIRMAN. How do this year's floods compare with floods of previous years?

Captain LEACH. The data are not in yet. There are some

peculiar developments that would require study before expressing a definite opinion. I would say as the result of what I have seen that I believe the flood at Memphis was about 5 per cent less than in 1882, the greatest in volume we have ever had, taking the whole length of the river. At Helena it approached closely to the 1882 flood, and below Helena it was the greatest flood of record in every respect except one—duration. In every other respect it was the greatest flood on record.

The CHAIRMAN. How does the land actually overflowed compare with that of 1882?

Captain LEACH. About 20 per cent as much.

Senator WASHBURN. Twenty per cent less than in 1882?

Captain LEACH. Only 20 per cent of what was overflowed in 1882.

The CHAIRMAN. What do you charge that to?

Captain LEACH. The levees. The overflow was made possible by the breaks in the levees. There were breaks of less than 2 miles, perhaps, in 1,300 miles. I may say, generally speaking, in regard to the possibility of maintaining a levee system for restraining floods, we have this year with the greatest flood on record approached more nearly the complete restraint of the flood than ever before.

The CHAIRMAN. Suppose the levees had not broken, would the overflow not have occurred?

Captain LEACH. The river was almost at its height before the breaks began, and from information which will be placed before the committee later it will be seen that the taking out of a very large quantity of water, at one place 400,000 cubic feet per second, had a very slight, unexpectedly slight, effect in reducing the height of the river. It is perfectly reasonable to suppose that an addition of 400,000 cubic feet per second would have had no greater effect in raising the river than the outlet had in depressing it. I think there is a great deal of evidence to show that with grades in some parts 2 feet higher than we now have, and in other parts no higher than now, and with levees thoroughly policed and controlled from the beginning of the flood, there would be few or no breaks.

The CHAIRMAN. What was the difficulty?

Captain LEACH. Defective foundations.

The CHAIRMAN. Whose fault is that?

Captain LEACH. I do not know exactly where to put it.

The CHAIRMAN. Were they built by the United States engineers?

Captain LEACH. Some of them, and some not; but the foundation was simply what nature left, not prepared foundations. I think, however, that we have underestimated the necessity of thoroughly exploring the foundations of the levee. I think all the engineers connected with the levee work are agreed upon that now.

The CHAIRMAN. Do the levees cave into the river?

Captain LEACH. Occasionally. The Commission within the last two or three years has distinctly committed itself to the policy of preferring, in the order of progress in bank protection by revetment, localities where the caving will involve large levees. I may say, generally, with regard to the history of the levee system, that over three-fourths, probably, of the entire sum of money expended by the States in the last ten or fifteen years in the construction of levees would have been saved if the United States had prevented the banks from caving.

Senator GIBSON. You said that this recent flood was the greatest flood of which you have any record?

Captain LEACH. Yes, sir.

Senator GIBSON. You mean in its height, or in its volume?

Captain LEACH. In its volume.

Senator GIBSON. You were speaking of the volume?

Captain LEACH. Yes, sir; but at some places it was greater in height.

Senator GIBSON. More water has passed down the Mississippi this winter in its flood stages than ever before?

Captain LEACH. I believe so; that is, below the mouth of the White River. The very top of this flood was caused by the discharge of a phenomenal volume of water out of the White and Arkansas rivers upon the fairly large flood which was passing Memphis.

Senator GIBSON. Have you any knowledge, from tradition or data, of the flood of 1828?

Captain LEACH. There is some data on that subject, but I am not familiar with it now. I have not looked at it for a long time.

Senator GIBSON. Have you heard from old people living in the valley anything about the flood of 1828?

Captain LEACH. No, I have not. The only thing I know about it is that there is a paragraph about it in the Humphreys and Abbott report, and what data there is collated there.

Senator GIBSON. You ascribe these breaks in the levees to the enormous body of water that pressed against them?

Captain LEACH. To the water against them, so long and with greater head than was ever known before in their history. By greater head I do not mean greater actual height of water in the river, but you know very well that if levees break extensively and back water rises behind them of course there is little or no head against them. In the flood of 1882 the levees, to be sure, were exposed to water perhaps 50 or 60 per cent longer than this year, but this year they were mostly dry behind.

Senator GIBSON. What are the facts, first, as to the number of miles that gave away this year in comparison with the floods of 1882 or 1884 and so on, and, secondly, the number of breaks?

Captain LEACH. I have here the report of a number of engi-

neers made to the recent Vicksburg convention. It is signed by about fourteen or fifteen engineers. This number comprises the United States engineers in charge of the district where the principal overflow occurred this year, two members of the Mississippi River Commission, and all the civil engineers engaged under all State organizations in the guarding and maintenance of levees during this flood. If anybody in the world has information about this thing these men have, and if any statement could be relied upon these gentlemen's statements certainly can.

"The disasters from the recent flood have been exaggerated and magnified beyond their true proportions by the sensational treatment, and which has tended to shake confidence in the efficiency of the levee system. In confirmation of this, attention is called to the following:

"In 1882 the total number of crevasses in the levees was 284, aggregating 589 miles in width.

"In 1883 the number of crevasses was 224, with an aggregate width of 341.1 miles.

"In 1884 the crevasses numbered 204, aggregating 106.04 miles in width.

"The result of the crevasses enumerated during these three years were the general overflow of the Mississippi delta.

"In the present flood, the dangers of which are nearly passed, the crevasses which have occurred number 23, aggregating about $4\frac{1}{4}$ miles in width in a total length of 1,100 miles of levee—one-half of 1 per cent of the total line of levees, notwithstanding that the present flood has exceeded those of the three years cited in the height attained and all points below, and has not exceeded in duration."

Senator GIBSON. I wish you would state what levees constructed by the Mississippi River Commission, or in accordance with their plans, by the Army engineers, have given away.

Captain LEACH. I really have no information on that point whatever.

Senator GIBSON. Has a single one given away?

Captain LEACH. I do not know. None of these levees are in my district.

Senator GIBSON. Yours is the Memphis district?

Captain LEACH. The first and second. This year we had but a single break, one at Austin, less than 300 feet wide.

Senator GIBSON. Built by the United States?

Captain LEACH. By the State.

Senator GIBSON. Has any of the work in your district built by the United States engineers given away?

Captain LEACH. No, sir.

Senator GIBSON. Are there any there?

Captain LEACH. Yes, sir; I have about 30 miles on one side

and 15 on another, 45 miles in all, at Plum Point reach, and about 15½ from Helena down. Half of this was built by the United States and all the Plum Point levees.

While I am on the subject of Plum Point levees I would like to make a little statement.

The Commission in carrying out the work in the early years at Plum Point had not provided for any levees. In a debate in the Senate on one of the river and harbor bills the point was made by a Senator that the Commission was professing to make an experimental application of their system at Plum Point reach and a part of their plan was a levee. That year an allotment was made and a levee built on the Tennessee side of the reach. The next year an allotment was made for levees on the Arkansas side and those levees were built. A party was engaged all the time in making surveys. The surveys made after the construction of the second line of levees and before the first flood and again after the first flood showed that the high bars in the regulated or deepened channel of about 3,500 feet width had had their tops scalped off 8 feet uniformly. Nothing of the kind had ever occurred before, and in the two crossings under control and under improvement the maximum depths had increased in one case 1 foot and in another case 2 feet, and they have remained to this time.

THE CHAIRMAN. Since the levees were built?

Captain LEACH. Yes, sir.

THE CHAIRMAN. Have you any idea what it would cost to repair these levees?

Captain LEACH. That would depend entirely upon the scheme adopted. My belief is now that we can strike with much more certainty than ever before. This flood, with all its disasters, has convinced me, and others, I think, of what we before believed, but could not prove—that is, that we can with reasonable levees confine any flood we are likely to have, and it seems to me that instead of working as we have heretofore we ought to change the plan altogether and give a little more money and reduce the risk. I think it is perfectly safe now—a year ago I would not have dared to say so—to have a scheme of levees that will be almost impregnable, and to do that I suppose will cost in the neighborhood of \$10,000,000 at prevailing prices.

THE CHAIRMAN. Ten millions for repairs alone?

Captain LEACH. To repair and enlarge and levee the St. Francis basin. To repair the present breaks alone, I think \$100,000 will do at present rates. The breaks are not very large and do not occur where the levees are very high. No very high levees have broken. The massive levees are all intact.

Senator WASHBURN. Let us understand what you propose to do with the \$10,000,000.

Captain LEACH. Ten millions will put up a line of levees 4

feet above the highest known water, with strong profile on the west bank from Cairo to the mouth of the St. Francis. That is the first thing. It will also increase the work at Plum Point to that standard. It will build up the White River front from Helena to and including Laconia to the same grade and profile. It will enlarge the Arkansas levees from the high land at Ames Ridge down past Arkansas City and on past the State line down to Red River. It will enlarge the lower district of the Yazoo front, and make some enlargements from point to point as may be necessary in the upper district. It will increase and strengthen the levees on both sides of the river wherever they now exist.

Senator WASHBURN. Would it build all the levees that are required?

Captain LEACH. Yes, sir.

Senator WASHBURN. What is going to become of the other \$65,000,000 which have been estimated for?

Captain LEACH. That sum will be required for the caving banks and for any other work that may be necessary in closing high water chutes, and in case of local obstructions of navigation, taking such means as may be necessary to remove them. I mean that the sixty-five millions will control the whole river.

Senator WASHBURN. How will the seventy-five millions be expended? You propose to expend ten millions for levees; how would the other sixty-five millions be expended?

Captain LEACH. In the first place I may say that sixty-five millions is the maximum estimate of any engineer connected with the work. My own estimate would be less than half of it, and I do not think my estimate is the lowest possible. Some of the money would have to be expended to protect the banks of the river from caving.

Senator WASHBURN. How do you get at that?

Captain LEACH. By a system of revetment, mattresses of brush ballasted with stone.

The CHAIRMAN. Have not some of these mattresses caved in?

Captain LEACH. Not recently. Not since we found out how to build them. We have not lost any since we found out how to build them.

The CHAIRMAN. Then, in your opinion, the amount of money that it required to build a canal from Manchester, England, to deep water will protect the Mississippi River from top to bottom?

Captain LEACH. Fifty millions will do it handsomely.

Senator WASHBURN. Do you agree with General Comstock that so far as the improvement of navigation is concerned, that is to be accomplished more by improvements in the bottom of the river than by levees?

Captain LEACH. No; I do not agree with him in that respect. I have stated my position as definitely as I can. I believe that the

improvement is progressive, that a little improvement is better than none, and that complete improvement is best of all, and is what the people need and demand. Partial improvement may be effected by partial control. Channel works will protect the river and control it so long as it is in its natural banks. Complete improvement is possible only with complete control. That is only possible by levees.

With regard to the specific way in which levees are made useful, I may illustrate by the practice in sewer constructions. Where the river makes a sharp bend at high water when it is well out of the banks, the fall across the point is equivalent to the fall around the bend. Therefore the rate of the fall is very much greater across the point. The result is that a greater or less amount leaves the channel at right angles and flows across the point. If you try to make a junction of a branch sewer with the main at right angles you will have considerable trouble. They do it effectually by bringing the joint at an acute angle. If water flowing squarely into a sewer will obstruct it, why would it not do the same thing in a river? There is only one way to keep it from flowing in and out of the river, and that is to build a levee. The water does harm when it comes out, and it does harm when it goes in.

The CHAIRMAN. I suppose the most important place is the middle of the levee where the water goes out, and returns in the same place.

Captain LEACH. Yes, sir. I think the levee should be made to follow the convolutions of the river as closely as the nature of the ground will permit. If they could be built at a uniform distance, a mile apart the whole length of the river, the conditions would be the most perfect that could be hoped for. If that is impossible, then the next best thing is to build them as nearly at a uniform distance apart as can be done.

STATEMENT OF CAPT. DAN C. KINGMAN.

Capt. DAN C. KINGMAN, Corps of Engineers, U. S. Army, in charge of the fourth district of the Mississippi River, appeared before the committee.

The CHAIRMAN. How long have you been in charge of the fourth district?

Captain KINGMAN. About three years and a half.

The CHAIRMAN. Please state your knowledge of the Mississippi River and its overflows, in regard to navigation.

Captain KINGMAN: The present discussion in regard to the Mississippi River has been relative to the effect of outlets on flood heights, and I have here a hydrograph which shows what outlets actually do to the river by showing what the crevasses which have taken place during this last flood have done to the flood heights. I have here gauges at some six or seven points in my district [indi-

cating on map]. This black line represents the gauge heights at Carrollton. This [indicating] at Bayou Sara; this [indicating] represents that at Red River Landing; this [indicating] is Natchez; this [indicating] is St. Joseph. The next gauge would be at Vicksburg, which is above my district.

These little squares here [indicating] represent a half day. This [indicating] represents one-tenth of a foot. Starting in here on the 1st of March and taking this gauge-reading at the next half day, I indicate the rise or the fall, and in this way the shape of flood wave is shown graphically by the curve that results from the union of all of [indicating] these points. It is the line that would be marked by a pointer which moved over two of these squares each day and also moved up or down one of these little squares for each tenth of a foot that the river rose or fell.

The river was at high stage on the 1st of March; about 14 $\frac{3}{4}$ feet at New Orleans, and at a corresponding height at the points above, and it continued to discharge at a very rapid rate the water that came down from above. The discharge amounted to 1,280,000 cubic feet per second at New Orleans on the 11th and 12th of March.

Up to that time no breaks had occurred. At that time a break occurred a little above College Point, at a plantation called Nita. This break was due to a rice flume, a cut made through the levee to admit water to the fields for the purpose of irrigation; this box or sluice had gates to it, by means of which the water could be admitted to or excluded from the fields. It was a timber affair and the pressure of the water forced the water around and under it and the box was "blown out," thus creating an opening which soon became a crevasse.

The CHAIRMAN. Do the people up and down these levees have a right to put in chutes and all that sort of thing?

Captain KINGMAN. Yes, sir; except in levees constructed by the United States, or unless there is a local parish law to the contrary. When they put them in they have to get authority from what would correspond to authorities of the county up here—the police jury, as it is called down there.

Senator WASHBURN. Are they in the habit of doing that to a great extent?

Captain KINGMAN. Yes, sir; hundreds of them. It is only in the rice-producing districts, however.

The Nita crevasse enlarged very rapidly. After it had been running for eight or ten days we measured the discharge and it was 90,000 cubic feet per second, the crevasse being about 600 feet wide, with an average depth of 15 feet. The water flowed out with great velocity in a fan-shaped body and inundated a great area of country. The crevasse increased in width in spite of all efforts to restrain it by driving piles and putting down a mattress. Now it is 3,000 feet

wide and 15 feet deep, discharging 400,000 cubic feet a second, or about one-half as much water as is now passing by New Orleans. Fine brick houses have been swept away and obliterated by this crevasse. So large an outlet as this ought to have produced a very marked effect on the river. If any outlet could do any good surely this one, discharging 400,000 cubic feet per second, ought to produce great relief.

Senator WASHBURN. What becomes of the water?

Captain KINGMAN. It flows out across the country downward and eastward until it strikes the old Bonnet Carré Channel and there the ridge formed by that crevasse prevents it from flowing down any farther. It goes across the country to Lake Pontchartrain, and the stream is 20 miles wide there. The track of the Illinois Central Railroad is under water for many miles, and that road can not now send trains to New Orleans. The water then flows through Lake Pontchartrain and passes out through the Chef Menteur, the Rigolets, and through the other outlets of the lake, and you can see the yellow water going out through the Rigolets far into Lake Borgne. Clear out into Mississippi Sound can be seen Mississippi water instead of the green salt water which is ordinarily seen there.

On the College Point gauge there was a fall up to the time the general fall set in of about a foot and a half. That is all the relief that place got in the way of a direct fall. At New Orleans there has been a fall from the highest point, until the final fall set in, of about a foot. The extreme height was 16 feet on the Carrollton gauge, and a foot was the extreme oscillation. The discharge through this crevasse has been shown to be nearly equal to one-half the volume of water now passing New Orleans. If we take out one-third of the water, we ought, if the conditions remained the same, to reduce the gauge height one-third. Therefore the Carrollton gauge ought to have gone down to about $10\frac{1}{2}$ feet, but it actually went down to about 15 feet.

Senator GIBSON. From 16 feet?

Captain KINGMAN. Yes, sir; until the final fall set in, due to some other causes. Therefore the relief from this was very slight. When we go up to Plaquemine, which is 50 miles above the crevasse, and compare the hydrograph with all the stations above, we see that there has been no effect from that crevasse.

The hydrographs at Bayou Sara and Red River correspond exactly. They preserved their own shape up to the 21st of April, when the crevasse occurred up there. We had there the Preston, Taylor, the Fannie Riche, the old Morganza and the new Morganza breaks, the Raccourci, and two or three others. These crevasses occurred by the water overtopping the levee. For 25 or 30 miles the levees had been raised. We fought the rising water until the levees had been raised 2 or 3 feet above the crown, and the water kept pace with us. Then a severe storm came and the waves swept

volumes of water over the levees, so that men were driven away from their work. Then the sand bags and planks which had been put on it yielded and broke and were carried away. None of the levees in those places broke from any other cause than simply by being overwhelmed by the water.

Senator GIBSON. You stated that at Plaquemine, which is only 50 miles above the Nita Crevasse, there was no change?

Captain KINGMAN. No, sir; no change at all due to this crevasse; though the several crevasses I have just mentioned, and with an aggregate discharge two or three days after they broke of about 237,000 cubic feet a second, being above Plaquemine, did produce some effect. They were all in there together within 10 or 12 miles, and the fall at Bayou Sara was about a foot in less than a day. They caused at the mouth of Red River the first day a fall of 2 or 3 inches, and in three or four days it amounted to about a foot. After that the fall was just simply that which was due to the fall of the river above. These several crevasses between Bayou Sara and the mouth of the Red River gave a discharge of 237,000 cubic feet per second. They gave more than that finally because they got larger, but I give this discharge so as to compare it with the effect that was produced at that time. Between Red River Landing and Natchez there were two small crevasses, the discharge of which I have not got yet. I had them measured, but have not received the measurements yet. As near as I can tell, their discharge must have been about 20,000 cubic feet a second. There was rather an abrupt fall at Natchez of about 4 or 5 inches, evidently due to that crevasse, and also due to another crevasse which occurred almost opposite Natchez, in Lake Concordia, which must have given a greater discharge. These crevasses caused an abrupt fall of 4 or 5 inches at Natchez. At St. Joe, a comparatively short distance above Natchez, there is absolutely no abnormal change in the hydrograph, and no fall due to crevasses occurred there at all. The river there takes its fall naturally, due to the natural fall coming down the river from above.

Senator GIBSON. How many miles up is St. Joe?

Captain KINGMAN. I do not know (referring to map.) Here is Natchez and here is St. Joe. I should say about 50 miles; about the same as Plaquemine was above the Nita. Down below the city there were a good many small crevasses, probably twelve or fourteen in all. They have all been closed but one, and in the aggregate their discharge might have amounted to 20,000 or 30,000 feet a second; but as they only stood open two or three days, and the people began to close them right away, and as they have since been closed, their effect is insignificant, and can not be traced on the hydrograph at all.

Now, to show what produced this remarkably high water below the mouth of the Red River, for it was remarkably high water: The Morganza levee had been built a foot and a half above high water

of 1882, and the water of this year would have gone over the top of that levee from 6 to 18 inches in depth if it had not been for the work we built on the crown. So that at Morganza, right at that particular bend, the extreme high water must have been from 2 to 2½ feet above the high water of 1882. We have got the high-water marks of this year, but when I was up there the 1882 marks were so far under water that we could not find them. At New Texas we had better luck. We found them 19 inches below the high water of this year. At Baton Rouge the river was 5 inches above 1882, if I remember right. I talked with a good many inhabitants of the valley—the oldest inhabitants probably—and they all admitted that they had never seen any water that approached the present water in height. They pointed to some of their old marks—trees, old levees, etc.—then submerged, which they said they had never known to be under water before. It was certainly the highest water below Red River that has been there within historic times.

On the 1st of March, before the levees had broken in Arkansas, north Louisiana, and Mississippi, the Atchafalaya at its head was about 6 or 8 inches lower than the Mississippi River at Red River Landing, and a good current was flowing from the Mississippi out into the Atchafalaya—not a very large discharge, but quite a considerable amount of water—and doubtless the Atchafalaya was affording some relief to the Mississippi. This continued until about the middle of March. Then the advance of the crevasse water that found its way down the Tensas began to appear below the mouth of Red River. It filled up the Atchafalaya and in a few days brought it above the level of the Mississippi, and the water began to return to this river. The inlet extended all the way from the Bougere Swamp down to the mouth of Red River. It was practically impossible to measure the amount of water coming out that way, because it flowed through the woods for miles and miles, and you could see the nearly clear crevasse water extending out 800 or 900 feet from the bank and pushing the Mississippi water towards the other side of the river. The effect seemed to retard rather than accelerate the current of the river. That is what caused the high water there.

The Atchafalaya has been carrying off an immense amount of water. The last discharge that we had measured was taken there on about the 1st of May. The Atchafalaya was then carrying nearly 5,000 cubic feet a second over the dams that we put in. It was not required when we put the dams in that they should permit the passage of over 200,000 cubic feet a second; and they would do this with a velocity of 4 feet a second. Now there is a velocity over the dam of about 9. The velocity is so great that steamboats can hardly stem it. In fact, some good steamboats have been forced to make two or three attempts before they could pass through that portion of the channel. A great many of the levees down below have given

away, and the Atchafalaya is spread out right and left, and covers the country down below Simmsport. There is no Red River water passing down the Atchafalaya at its head now. The Red River begins to show itself in the river near Simmsport, 6 miles from the head.

Senator GIBSON. Does the Red River go on the north side of Turnbolls Island now?

Captain KINGMAN. There has been a channel there always—a clear and well-defined channel—but not quite as deep a channel as on the south side.

Senator GIBSON. It was thought that the sills would turn it around.

Captain KINGMAN. No, sir. They were placed about 6 miles down the Atchafalaya, and had no effect upon the water of the Red River. A sill was built last fall to connect Turnbolls Island to the main line, between the old mouth of Red River and the head of the Atchafalaya. A dam is to be placed upon this sill, and when the dam is put in there it will doubtless cause the river in low stages to pass around the north side of the island.

Senator GIBSON. Now, while there were 500,000 cubic feet per second going out the Atchafalaya, how much was going down the Mississippi? That was all Mississippi water?

Captain KINGMAN. Pretty much. It did not come directly out of the Mississippi, but it was all crevasse water. There was about 1,450,000 cubic feet a second going down the Mississippi below Red River Landing at this time—that is, in round numbers.

The CHAIRMAN. What is your conclusion about the outlet system at Lake Borgne?

Captain KINGMAN. It would be a disappointment. It would not afford the relief which is counted on; it would be an entire failure as a means of relief from overflow. If it did any good at all, temporarily, it might do good from the outlet down to the mouth of the river, where there is no land of any particular value. A narrow strip of land runs along the river from Lake Borgne to the forts, which is about as liable to overflow from the back water as it is from the front water, and this danger would be increased rather than diminished by the discharge of the Mississippi through the outlet above it. Finally, I do not see why there should be any more relief at New Orleans from this Lake Borgne outlet than there was at Plaquemine from the Nita Crevasse. I think that we have an absolute demonstration of what an outlet will do. Here is a crevasse which is now flowing, and this is what it has done. Below the crevasse it has afforded a little relief, but nothing like commensurate with the amount of water taken out, and above the crevasse it has afforded no relief at all.

Senator WASHBURN. Do you not think the Atchafalaya has given relief?

Captain KINGMAN. I think it has, yes, sir; but I think it has done so because the condition of the Mississippi River near the mouth of Red River is an abnormal one. The Atchafalaya has been there so long that the river has adapted itself to that condition. Now, the Mississippi River flows in a channel of its own formation, and if you were to compare a map of the river of fifty years ago with the map of the present day you would find that the channel of the Mississippi is entirely different. If it occupies the same channel now that it did then it would most likely be because it had gone away and come back again, except at the lower end of the river, where the changes in the channel are less rapid. This channel has a certain size. It is of a size sufficient to carry its average flood discharge. Whenever it has to carry a discharge which is greater than the average discharge it is overtaxed. If it had only to carry half the water it does now it would have only half its present capacity of channel.

The CHAIRMAN. Was not the channel of the Atchafalaya dry in 1840?

Captain KINGMAN. It can not be said to have been dry; it had a very much less capacity of discharge then than it has now. I think in 1836 the State removed, or partially removed, the raft in the Atchafalaya, which was situated from 12 to 20 miles below its head. This was a mass of trees, logs, and drift. It was partially floating and the water ran under and through it, but while it greatly diminished it did not absolutely stop the discharge down the Atchafalaya. Old people living on the Atchafalaya have told me that at the head of the river they crossed in low water on a single fence rail at a place where it is now 1,000 feet wide and 100 feet deep.

The CHAIRMAN. It has been making an outlet of itself?

Captain KINGMAN. Yes, sir; it is a case different from any other of the outlets on the Mississippi. My own idea is that the Atchafalaya is not a natural outlet of the Mississippi. It is not a part of the delta proper. I think there were originally three independent rivers flowing into the Gulf, namely, the Red River, which reached the Gulf through the Teche; the Black River, which flowed through the Atchafalaya, and the Mississippi River. Those three rivers flowed in their own separate channels. In the course of time the Red River obstructed its own channel near the head of what is now the Teche; its water was forced north of the Avoyelles prairie till it found its way into the open channel of the Black River. The Red River thus became a tributary of the Black River. The Red River continued to be a raft maker, and in time it obstructed the channel of the Black, or what is now called the Atchafalaya. At this time the Mississippi River caved in to the Black River at a point below its junction with the Red, and both of the rivers became tributaries of the Mississippi, and would have remained so if new

conditions had not been set up by the removal of the Atchafalaya raft.

The CHAIRMAN. These rivers are tributaries to the Mississippi, but at a certain stage of water the Mississippi becomes tributary to them?

Captain KINGMAN. Yes, sir. The Red River flows now, since the raft has been removed out of the Atchafalaya, down the Atchafalaya to the Gulf. The Mississippi occupies its own channel. They are connected by Old River like the Siamese twins. If the water in the two rivers is of the same height there is no circulation. If one is higher than the other the current is from the higher to the lower. If the Red is the higher, then its water divides and part goes down the Atchafalaya and the rest goes out to the Mississippi. If the other condition prevails, then all the Red River goes down the Atchafalaya and a part of the Mississippi goes over until it raises up the Atchafalaya enough to establish a condition of equilibrium, and so the water flows. That is the reason that the Atchafalaya does not close up, because it always has the Red River to act upon it. Sometimes it has the Mississippi.

Senator GIBSON. It is both an outlet and an inlet?

Captain KINGMAN. It is not exactly an inlet. The Atchafalaya does not flow into the Mississippi.

The CHAIRMAN. Did it never flow into the Mississippi?

Captain KINGMAN. No, sir; it never was a tributary to the Mississippi. I think it was the lower half of Black River. It was not a part of the delta of the Mississippi. Its banks are a black, clayey deposit, and upon that is found a red deposit, and upon that it is sandy. It looks like the work of the Black River and then of the Red and Black combined, but it is clearly an independent river by itself, with this accidental connection between it and another river. It always has the Red River to flow down, and it is no more likely to deteriorate than if the Mississippi was not there. That is the reason it does not fill up like the other outlets.

The CHAIRMAN. Are you familiar with the methods of the Mississippi River Commission in improving the Mississippi River for navigation?

Captain KINGMAN. No, sir; not very familiar. My district only goes up as far as Vicksburg. There have been no channel improvements in my district, so that what I know of the channel works has been only what I saw in passing over the river, or what I read about them in the annual reports. All the work I have done has been local, such as at the mouth of the Red River, New Orleans Harbor, and the construction and maintenance of levees.

The CHAIRMAN. In your district, as between levees and outlet system, you have no doubt?

Captain KINGMAN. I have not a particle of doubt.

The CHAIRMAN. Suppose you drop all considerations of overflows and regard navigation alone, how then?

Captain KINGMAN. I should consider that the levee is a very important means of improving navigation, and I can give an instance. The Morganza crevasse was caused by a break that occurred in 1874. It remained open as a crevasse practically until closed in the winter of 1886 and 1887, a period of about twelve years. It has a deep bend there and plenty of water, and there had been no trouble with the navigation until after the crevasse was formed. After the crevasse occurred the navigation became worse and worse, and steamboat men told me they hated to run that bend at night, particularly in low water, not when the water was running out. When the water was running out there would seem to be danger of being drawn into the crevasse. The steamboat men dreaded it at low water because the sand-bar, or tongue of land opposite this bend, had extended so far over into the bend that there was hardly room enough for two large steamboats to pass there. The crevasse was closed, jointly by the Commission and by the State, in the winter of 1886 and 1887. Since then the navigation has steadily improved until now it is as good as it ever was. The current is quite regular. There is ample room now, and steamboat men have spoken to me repeatedly this year about the great improvement which has taken place in Morganza Bend since the crevasse has been closed. There is an actual case where the building of a levee made bad navigation good.

Of course, at Bonnet Carre there was a crevasse open for a long time, but the river was so deep at that place, there being no abrupt bend, that the navigation did not get bad. It certainly got worse than it was, but to reduce a channel from 60 feet down to 40 feet, when the boats draw but 10 or 12 feet, does not make any difference, so that a sounding line would be required to show that the channel depth had deteriorated and afterwards been restored. Of course, there was not enough change there for steamboat men to notice. This Morganza case is a good one in point.

The CHAIRMAN. Where does the Morganza water go?

Captain KINGMAN. It passes down through what is known as the Choctaw Swamp, until it comes down nearly back of the town of Plaquemine, and there it finds its way through an intricate system of channels into Grand Lake, and ultimately goes out in Lower Atchafalaya Bay.

Senator GIBSON. How many breaks or crevasses did you have in your district during the whole season?

Captain KINGMAN. About 32.

Senator GIBSON. How many did you close?

Captain KINGMAN. Out of this number we closed about a dozen.

Senator GIBSON. That would leave about 20?

Captain KINGMAN. Yes, sir.

Senator GIBSON. How many miles?

Captain KINGMAN. A little less than 2 miles would be the total length of them.

Senator GIBSON. How many of those crevasses occurred in works built by the United States engineers?

Captain KINGMAN. If I recollect aright, there was but one; that was the Morganza. That broke in the manner I have described; the break was right in the center of the new Morganza.

Senator GIBSON. How much money would it take to put up these levees and raise them to flood heights—that is, to the heights at which you raise them?

Captain KINGMAN. I have not made an estimate of what it would cost, but I think most of the breaks can be closed right in the throats of the crevasses. Where a break is 500 or 250 feet long, to build that short distance and to raise it 2 or 3 feet above the general height of the levee would hardly be logical. To restore the levees to the condition they were in before the breaks occurred would cost \$100,000. That is a liberal estimate, and I do not think it would cost more than that.

Captain LEACH. I think the whole system can be restored to the condition in which it was before this flood occurred by the expenditure of in the neighborhood of \$100,000.

Captain KINGMAN. It would cost in the neighborhood of \$5,000,000 to make them perfect in my district—that is, to put them up 5 feet higher than they now are from Vicksburg to the mouth of Red River, 4 feet from there to New Orleans, and 3 feet from there to the Forts; and to give them, at the same time, the proper slopes.

Senator GIBSON. Your district would have to be leveed on both sides?

Captain KINGMAN. Yes, sir; from Baton Rouge down. That is more than half the distance.

Senator GIBSON. Have you ever been to Holland?

Captain KINGMAN. No, sir.

Senator GIBSON. On the River Rhine or the Danube?

Captain KINGMAN. No, sir.

"THE LEVEE THEORY ON THE MISSISSIPPI RIVER,"
AN INFORMAL DISCUSSION AT THE ANNUAL CON-
VENTION, AMERICAN SOCIETY OF CIVIL ENGI-
NEERS, JUNE 10, 1903.

B. M. HARROD, Past President American Society of Civil Engineers. The question whether a theory is justified by experience is hardly fair, when its application is quite incomplete, as is the case on the lower Mississippi River, where the levees have as yet neither the grade, section, nor extension considered necessary, and the present contents in cubic yards are not more than two-thirds of the quantity required by the adopted standard.

The discussion of the subject, however, is opportune, as a recent flood of magnitude has excited interest and afforded much information.

The justification of the "Levee Theory" is involved in such changes in the bed of the river, as a flood channel, as result either from natural causes or from an increase of the discharge by levees during more than bank-full stages. If the bed is rising, or the capacity is otherwise reduced by natural and continuing conditions, the completion of a levee system will be prolonged, if not made interminable. If the bed is not rising and the waterway is maintained or improved, either by deepening or widening by the discharge of a larger volume at higher velocity, then the problem, though large, is simple and certain.

The Mississippi River Commission, therefore, has given careful investigation to such changes since its appointment. Local and seasonable movements are constantly going on. At certain stages bars build up and pools scour. At others this process is reversed. Besides this, there is a general downstream and snake-like movement of the sinuosities of the stream. The current binds against the upper and is slack against the lower side of points. Therefore the points, with their opposite concavities, move slowly downward from erosion on the upper and accretion on the lower side. The location of the pools and bars has a definite relation to the curvature of the bends, the former lying in the concavities, alternately on the right and left banks, and the bars at the nodes or revision points between the pools. Hence, as the bends move downstream the bars and pools move with them. Again, as a result of caving on one and accretion on the opposite bank, the river shifts sideways. Instances are not wanting where this movement has amounted to its entire width in fifteen or twenty years.

It is evident that with these unstable conditions but little can be learned from isolated or scattered surroundings. A cross-section

line over a bar may, in a few years, lie through a pool, or the river may have slipped to *one side*, leaving it on dry ground.

In the years 1881, 1882, and 1883 the Commission made an exact and detailed survey of the river from Cairo to the Head of the Passes, a distance of 1,063 miles, with cross sections averaging about four to the mile, and seventy-five soundings to the line. There was no better way of investigating this difficult and important question than by repeating the survey. This was done in 1894, 1895, and 1896, after an interval of thirteen years, over that part of the river where the levee system had been most improved during the interval, from the mouth of White River to Donaldsonville, La., a distance of 472 miles. This second survey was made in greater detail, in order that it might better serve for future comparisons.

There is a limit to the value of the results obtainable even by this exhaustive process, of which the Commission was aware, but no better method seemed available. A comparison between the two surveys would be conclusive in proportion to the similarity of the stage conditions preceding them and prevailing while the parties were in the field. Each survey was of such magnitude and detail as to require several months, and it was improbable that there would be a close repetition of the conditions of the first during the second.

Both surveys and the analysis of their elements were made under the charge of J. A. Ockerson, member American Society of Civil Engineers, and his detailed report on them is found in the reports of the Mississippi River Commission for 1896 and 1897, published, respectively, in the sixth and fifth parts of the reports of the Chief of Engineers for those years.

The following conclusions from his study of the conditions are well founded:

The differences found in these two surveys do not necessarily represent all the changes or the resultant of all the changes that may have taken place between them. During this time the conditions of the river bed may have varied in both directions from those found in either survey. They should, however, indicate any trend, or persistent and progressive change that has taken place. This general tendency seems to be toward a channel more uniform in depth and of greater capacity.

The conditions under which the two surveys from Vicksburg to Donaldsonville were made were so different as to give abnormal results. The first (1882) was after the greatest recorded flood and on the rise of the succeeding one, which was of considerable magnitude, while the last (1895-96) was preceded by two seasons of extreme low water, and a very moderate intermediate flood, during which sediment transported from above would be deposited in the lower part of the river, particularly below Red River, where a relatively large low-water section, flat slopes, and correspondingly small velocities are found.

A duplication of the survey of 1881 is now being made over that part of the river from Cairo to the mouth of the Arkansas, along which the levee system has been much extended since 1895. In the future, at proper intervals of time, similar resurveys will be made over the entire river, until they yield indications of a persistent and progressive change.

It may be assumed that the low-water plane conforms to the shape of the river bed, and that any elevation or depression of the latter, as the result either of natural causes or of levee building, will be recorded in the low-water gauge readings. The improvement of levees during the past twenty years, and their effect in increasing the height of floods, has been most marked in the 500 miles of river in which are included the gauge stations of Fulton, Memphis, Greenville, and Lake Providence. There has, as yet, been no levee building which has affected the flood stage at Cairo. The effect on the bed of the river, therefore, may be observed by comparing the low-water stages at the points where levee improvement has been greatest with those at Cairo where no influence of the kind has been felt.

Prior to 1882 the United States had built no levees, and the insufficient and incomplete State levees existing at the time were badly wrecked by the flood of that year, which left them in quite an unserviceable condition.

If the average of the low waters at the points mentioned above, which have been selected as fairly representative, for the five years following this disaster of 1882 (1883 to 1887) and that of the last five years (1898 to 1902) be compared with the averages of the low waters at Cairo during the same two periods, as a standard, there will be observed, during the latter period an average relative depression of the low-water surface of 0.74 foot at Fulton, 0.68 foot at Memphis, 1.60 feet at Greenville, and 1.89 feet at Lake Providence.

These reductions of the low-water plane are indicative of a depression of the bed, and are proportionate to the duration and degree of levee maintenance and improvement in the vicinity of the gauge stations mentioned.

Table No. 3 will make this statement clearer.

It was observed, in the great flood of 1897, that:

"The first gauge below Red River to exceed its previous record was the lowest one on the river, at Fort Jackson. The next was the Carrollton gauge, and so on up to Red River, where the gauge did not exceed its previous record until sixteen days after the Carrollton gauge had done so. When the Carrollton gauge had reached its previous maximum, that at Red River still lacked 1.6 feet of the height which had produced that maximum."

The same prematurity of rise at the lower-gauge stations occurred during the present year. In a discussion of this phenomenon by Major Derby, member American Society of Civil Engineers, in

the Report of the Mississippi River Commission for 1900, it was considered as due to one of only three causes: (1) A raising of the bed of the river below Carrollton; (2) the effect of crevasses and their closure, or (3) an increase of the carrying capacity of the channel between Red River and Carrollton by which the resistance to discharge and the slope over that 200 miles of river was reduced. His analysis of flood waves ranging in height, at Red River, from 19.3 to 45.2 feet between the years 1872 and 1899, discredited the first two causes and led to the conclusion that the discharge capacity of this part of the river had been increased during the period under consideration.

Besides these extended comparative observations, others of a more local character have been made in connection with crevasses or temporary outlets, as at Malone's, Riverton, Bolivar, Mound Place, Morganza, Bonnet Carré, and Cubitt's Gap. Whenever the resurvey was made after the occurrence of an outlet it showed a reduction of the cross-sectional area below. When made after closure, an enlargement has been observed.

When, in 1880, the river was first subjected to continuous observation, the levee system was in its infancy; some basins were entirely unleveed, and such crude levees as existed were breached at many places by every high water. It was then noticed that the rise and fall was very different at different places. When classified, the greater annual oscillations, amounting generally to about 45 feet, were found at or near the mouths of the tributaries—the Ohio, St. Francis, Arkansas, Yazoo, and Red rivers—while the lesser ones, averaging only about 35 feet, were observed at intermediate points along the fronts of the great basins drained by these tributaries, as at Fulton, Memphis, Greenville, Lake Providence, and St. Joseph.

The gauge readings, when plotted, showed a smooth and regular high-water slope, while that of the low-water slope was quite irregular, being depressed about the junctions of the tributaries, and raised between them or along the basin fronts. A diagram of the high water of 1882 and the low water of 1883, Fig. 2, shows that these differences in annual oscillation were caused not by the rise but by the excess of fall at the tributaries over that on the bars of the elevated bed of the river between them.

It was further indicated by the discharge observations taken at high waters at the places near the tributaries and at the others along the basin fronts that the discharges at the former were about 1,500,000 cubic feet per second, and exceeded those at the latter, or intermediate points along the basin fronts, by several hundred thousand feet.

This difference, from a quarter to a half million feet at times, had escaped from the river bed over the banks into the basins, and was returned to the main river below through the tributaries, which are the outfalls for their normal and overflow drainage. Where the

river discharged between the banks the entire flood volume, the bed was deepened; and where it discharged only two-thirds of that volume the bed was shallowed. The depletion of a thousand floods by overflow had impressed this shape upon the bed.

A part of the "Levee Theory" is that the escape of flood water from the river along the fronts into the adjacent basins caused the elevation of bed that existed, as evidenced by the low-water slope; and that, when this is prevented by levees and the discharge confined, a primary effect will be the reproduction, in the high-water slope, of those elevations which have been observed and described in the low. This has already been brought about by the extension and improvement of levees, and is measured by the excessive height of recent floods at points situated along the middle of basin fronts, as Memphis or Lake Providence. It will be observed that an equal increase of heights has not occurred at the mouths of the tributaries.

Another part of the "Levee Theory" is that a reversal, or removal, of the conditions which have contracted one part of the waterway and relatively enlarged another, of the same river, will remove these differentiations, and that with a uniform discharge for each stage, from Cairo to the sea, affected only by increments from the normal drainage of the basins, through an erodible bed which the river has molded to its needs, these irregularities of slope, velocity, and section will disappear, and that there will result a regular and substantially parallel slope curve flattened a little by each increment of volume from a tributary, until Red River is reached, and from thence down the slopes at all stages will converge to sea level.

If the flow is as great along the basin fronts as at the tributaries, why should not the channel capacity of this strictly sedimentary stream be as great at one place as at another?

The condition in which the Commission found the river, and of which a description has been attempted, is the result of many centuries of alternation of channel depletion and enlargement at every flood stage. It is not to be expected that an accumulation of deposit, almost geological in its age and its mass, will be removed by five or ten years of levee improvement, or by a few great floods occurring at intervals of five or six years. But, with the force and time we have on hand, the result is not in doubt. The evidence of a start in this direction is given in a previous part of this discussion.

The result of all observations seems to show a general tendency to an enlargement of the stream, that its capacity for flood discharge has been more than maintained, and that the apprehension of its deterioration, from natural causes, or from levee building, may be dismissed as, at least, unproved, if not disproved.

Consideration must also be given to the floods of the future, which will seek an outfall through the channel below Cairo. Will they be of greater volume than those of the past? They come from

four sources, the upper Mississippi, the Ohio and the Missouri watersheds, and from the tributaries of the main trunk below Cairo. It may generally be stated that, when the first three form a combination which causes a dangerous stage on the lower Mississippi, about two-thirds of the discharge, or 1,000,000 cubic feet per second, is contributed by the Ohio. This is the controlling factor in great floods.

While the relation between deforesting and precipitation is assumed rather than established, there is no doubt that the processes of clearing, draining, and cultivating may materially affect the distribution of the run-off, delivering to the streams of outfall a larger share in a shorter time, and tending to higher high waters and lower waters. Under certain topographic conditions, these results may be limited and even reversed. It is, therefore, an important part of this discussion to consider the bearing which the conditions of the four sources of supply have had, and will have, upon the high waters of the lower Mississippi.

It seems probable that the future changes in the flood conditions in the upper Mississippi Basin will be slight. The forests, or those having commercial value, have been very largely cut down, cultivation under improved methods is already greatly extended, the reservoir system may be increased, and while the projected discharge of the Chicago Canal, constituting about one-tenth of the low-water discharge of the river below Cairo may be appreciably beneficial to low-water navigation, its contribution of about one-half of 1 per cent to the flood volume is too small for consideration.

It is unfortunate that the records do not extend far enough back to give a life history of these tributary rivers, the gauges having generally been established within the last thirty years. Fortunately, since it bears on the most important flood factor, Cincinnati is an exception, having a continuous record of forty-five years. An examination of this shows that, if this period is divided in halves, the average of flood heights on the Ohio in the first half is 48.80, and in the second 52.37 feet. If, however, it is divided into thirds, they give the following relation of averages for the three periods: 48.51, 52.57, and 50.69 feet. For low water the average result for half periods is 3.80 and 3.86 feet, and for thirds is 3.83, 3.60, and 4.06 feet. It does not appear, therefore, that on the Ohio River, for the last forty-five years, there has been a progressive change to higher high waters to lower low waters (although the processes to which such a result is usually attributed have presumably continued), but rather that some conservative or restorative influence has been in operation.

The high and low waters at Cincinnati for the period under consideration are shown in Fig. 3.

The physical conditions in the basin of the Missouri are materially different from those in the Ohio. Except about the head-

waters, it is a region of gentler slopes, largely without forests. Its progressive occupation and cultivation will be accompanied by plowing and planting surfaces which are now smooth and barren, and probably by a great development of reservoir building for irrigation. The tendency of these processes should be to check the rapidity with which its floods are discharged, and render less likely their coincidence with those of the Ohio, which generally culminate in February or March.

The tributaries below Cairo may be grouped together for consideration. While some of them head in arid regions similar to those drained by the Missouri, they generally flow through flat alluvial lands, where drainage is and always will be slow, and where the prevailing forests will be gradually replaced by a cultivation which will not materially hasten the run-off. With overflow excluded from the basins, there is no reason apparent why the natural discharge of these drainage systems should be materially increased in the future.

If not levees, what then? Reservoirs, or outlets?

The tendency of any extension of a reservoir system on the upper Mississippi or Missouri would be to abate floods on the lower Mississippi, but probably to a degree hardly appreciable. Such a system on the Ohio, if practicable, might produce more important results. But the late Milnor Roberts, past president American Society of Civil Engineers, closed this part of the subject forever in his most able report of 1870.

Outlets have received theoretic support in the report of Humphreys and Abbot, and of the United States Commission of Engineers of 1875 for the reclamation of the alluvial basin from overflow, but, after a detailed examination, they are unanimously:

"Forced unwillingly to the conclusion that no assistance in reclaiming the alluvial region from overflow can judiciously be anticipated from artificial outlets. They are correct in theory, but no advantageous sites for their construction exist."

The views on which these theoretical conclusions in favor of outlets were based, viz: that the bed of the stream was in a material so inerosible, and that changes in volume and velocity bore so little relation to scour or deposit, that its shape and dimensions would not respond to these changes, have not been upheld by more recent and exhaustive observations. These show that the bed is in a material which is being moved by the current from day to day and from bar to bar, and that its shape and dimensions are the resultants of this force.

The experience in levee building is that the limit to which the use of the material and methods of their construction can be safely extended has not yet been approached. The larger levees, which reach, in sloughs or other depressions, a height of 30 to 40 feet, and even more, are generally considered as among the safest.

Many substitutes and reinforcements for the earthen embankment, of various materials and construction, wood, stone, steel, concrete, etc., have been proposed. But when all things are considered, including ease of construction, economy, and endurance, the outlook at present is that a carefully constructed earthen levee system, with sufficient grade and section, when properly cared for, presents advantages with which competition will always be extremely difficult.

There are two natural conditions prevailing on the Mississippi below Cairo which add materially to the practicability and efficiency of the "levee system." One is the general presence of Bermuda grass, which grows with closely interwoven stems, attached to the ground by root tufts at close intervals, and forms a dense sod, presenting great protection against wave wash. The other is the high charge of sediment carried by the river at its higher stages. As the water seeps into and through the levees, it is filtered, the particles being deposited in the interstices of the soil of which it is built. The clear water percolates through to the land slope, while its charge of sediment remains and gradually diminishes the leakage.

The experience concerning the cost of making good the losses sustained by the existing levees, from caving banks and breaks from other causes, has been collated for the past eight years. It amounts annually, during that period, to a little less than $1\frac{1}{2}$ per cent. The losses by the flood of this season and by certain important works of renewal now in sight will probably temporarily increase this annual cost in the near future. Also, as the levees approach the grade and section which it is considered necessary to give them, and their contents per linear foot are thus increased, the work of closing any gap that may occur will be proportionately greater. On the other hand, the better locations, construction, and care which are already made possible, to a certain degree, and which can in the future be practiced to a still greater extent, from the more liberal and regular supply of funds, should tend to a reduction of the annual losses from caving banks and the occasional losses from extreme high waters.

This increase of resources can be expected both from a fuller realization by the General Government of the importance of the work which it has undertaken, the reclamation from overflow, and the agricultural and commercial development of 20,000,000 acres of the most fertile soil, and from the increasing number and wealth of the communities now occupying and improving these lands.

The amount applied to the extension and improvement of the levee system of the lower Mississippi in the year 1900 was about \$2,961,000. Of this, about \$1,000,000 was allotted from the appropriation by Congress for the river below Cairo, and the remainder was supplied by the levee organizations of the riparian States. This is substantially the division of cost which has prevailed since the Government has shared in the construction of a levee system. Several of these local organizations now feel justified, by their experi-

ence with the "levee theory," to seek legislative authority for an increase of their contribution by additional taxation and bond issues.

When the levee system of the lower Mississippi shall have been completed, it will still be but an engineering structure, subject to the vicissitudes of time and accident. It will need constant care, and occasional renewal of parts. Crevasses will occur as long as trains are derailed, or collide, as ships are wrecked, or fireproof buildings are destroyed. A crevasse in the levee of the future will be a more serious disaster than in one of the present time, in proportion to its greater depth and discharge, and the greater improvements which have developed under its protection. But this is the case with all of our work, whose progress has not been deterred by the greater risks which are necessarily assumed in meeting the demands of modern civilization.

This discussion, already too long, will be closed with a short comparison of the floods of 1897 and 1903 and their results.

The computations of the discharge measurements of the last flood are not yet complete, but it is apparent that the maximum discharge of 1897 was slightly more than that of 1903. Greater heights were generally reached this year, mainly along the fronts of the basins where levees have made the greatest reduction in the overflow, but not at the mouths of the tributaries. This increased height was due both to the extension of levees along hitherto unleveed fronts, and to the improvement made in the existing lines since 1897, which enabled them to exert more resistance and control.

The greatest increase of flood height this year was about 3 feet at Memphis, where levees have been but recently extended. Nevertheless, there were, in 1897, between Cairo and New Orleans, a distance of 960 miles, forty-three crevasses, while during the past flood, so great had been the improvement of levees in the meantime, there were but six. While the limit of the overflowed area has not yet been completely ascertained, it is known to be reduced largely, if not quite in proportion to the lesser number of breaks.

The experience of 1903 makes advisable a revision of the provisional standard in the vicinity of some of the gauge stations.

It will be observed that no high water has yet reached the predicted standard.

The engineers engaged in the reclamation of the valley of the Mississippi River from overflow know more about levee building than they have yet had the opportunity of putting in practice. They are quite aware of many and much-needed improvements, both in their construction and in their care and preservation. Up to the present time the compelling need has been, and for several years will be, continuity of line, higher grades, and standard sections. Those used provisionally are everywhere below those considered safe for great floods, and the present contents of levees are not more than 60 per cent of what is considered necessary for satisfactory protection.

Yet behind this partial shelter population has increased, values have risen, wealth has accumulated, comfort and culture have developed, and great railroad systems have extended at such a rate that it can be said that the reclamation of this region is one of the most successful and beneficent public works now in progress.

J. A. OCKERSON, member American Society of Civil Engineers (by letter). In early days, prior to the advent of the levee system, the steamboat man and the passenger going down the Mississippi River saw a narrow strip of cultivated land along the immediate banks of the river. They did not realize that for 40 to 60 miles beyond that strip the alluvial basin was practically uninhabited and its rich soil untilled.

They saw the fields covered with water during flood times, to a depth of perhaps 3 or 4 feet, and very limited areas in certain localities, developed by radical changes in the regimen of the river, were known to be above water except during extraordinary floods. They did not appreciate the fact that perhaps 5 miles farther back the water was 10 feet or more in depth, that without levees to control the floods these great interior basins could not be inhabited or cultivated.

In the meantime, systematic levee work began, and year by year the levees are gradually being brought up to such height as will finally effectually carry the greatest floods safely to the sea. These same men notice that the flood water on the battures and the lands between the levees gradually becomes deeper and the levees grow higher, and they conclude that if the levees can ever be made to control the floods at all they will ultimately "reach the tree tops in height." They are fully convinced and most positive in their opinion that the increase in flood height is due to the raising of the river bed.

To the engineer it is no surprise that there should be an increase in the height of a flood confined between levees from 1 to 5 miles apart over that of a flood confined only by the hills that limit the basins with a width of 40 to 60 miles. More than that, the engineer, in the beginning of the work, computed the heights which the maximum confined flood would ultimately reach, and the results have shown that his calculations are very near the mark.

Everyone familiar, even to a slight degree, with the physical characteristics of the river, has noticed the extraordinary local changes that occur in brief intervals of time. Very few, however, realize the fact that tangible changes in the general regimen of the river require long periods of time.

The belief among laymen that there is a general progressive elevation of the bed of the stream going on, which is augmented by levees, is widespread. Statements have been made, by those who ought to know better, that the bed of the river at New Orleans is higher than the adjacent land, while the fact is that the bed is some 200 feet below the land.

A former Secretary of War, in discussing this question with the writer, stated that he proposed to settle the vexing question himself by "measuring the river in several places." Just what he intended to compare the measurements with, or how he proposed to eliminate the effect of purely local changes, does not appear.

The statement that the Mississippi River Commission had already made many thousands of such measurements, covering some 425 miles of river, may have had something to do with the abandonment of his project.

Without any preconceived theory to prove, and with a view of simply ascertaining the facts in the case, the writer prepared in 1894 a project for a resurvey of the river from the mouth of the Arkansas River to Donaldsonville—a distance of 425 miles—and this project was approved by the Mississippi River Commission.

The first general survey had been made, much of it under the personal supervision of the writer, some twelve to fifteen years prior to that time. This first survey comprised accurate lines of levels, with established bench marks at intervals of 3 miles. Each line of soundings across the river (at frequent intervals) had its water-surface elevation determined by levels, hence an accurate cross section of the bed could be plotted. Surveys made at the later date, referring to the same bench marks and the same datum, gave reliable data from which to determine the difference in conditions at the two epochs.

A careful comparison of the two would, of course, disclose any general changes of considerable magnitude in the elevation or capacity of the bed.

The thousands of cross sections of the two surveys were carefully plotted, their respective areas measured, and their mean and maximum depths determined. Then comparisons were made between individual sections and between corresponding groups of sections comprising successive pools and crossings. All this entailed an enormous amount of painstaking work, and the conclusions are as follows:

The crests of the low-water bars, as well as the high-water bars, were found to be lower. About half of the total length resurveyed showed a depression of the thalweg, and about an equal amount showed a slight elevation, confined chiefly to the pools.

The results reached by this investigation are not as specific as might be desired, but it does not seem possible that such great elevations of bed as would be required to account for increased flood heights could escape detection.

Embracing, as it did, a comparison of 2,768 cross sections of the river, together with something like 150,000 elevations, it seems to prove beyond a reasonable doubt, if any such proof be really needed, that the elevation of a confined flood in the Mississippi is not due to the elevation of the bed of the river.

There is a still more simple proof which should be satisfactory to all, even if highly prejudiced against a levee system.

Gauges are established at intervals along the river, and are connected with several permanent bench marks in the immediate vicinity. Frequent inspections keep the gauge zeros at the same height from year to year. The readings are taken by reliable observers, both morning and evening, and a continuous record is thus maintained throughout both high and low waters.

These records show in the most positive way that the low waters of recent years are several feet lower than those of earlier years, with equal volume of flow and with equal channel depths.

Only one explanation of this condition is possible. It points unerringly to a depression of the bed of the stream, and should effectually set at rest any fears that there is such a thing as a tangible progressive elevation of the river bed.

During the height of the flood of 1903 the Mississippi River Commission viewed the river from St. Louis to the Gulf of Mexico. Anyone who could have seen, as they did, hundreds of miles of levee intact, the farmers behind them busy plowing and planting, the fruit trees in bloom, the stock fattening on the green herbage, would surely have been impressed with the efficacy, the necessity, of levees.

Add to this the knowledge that the levee system had served to fill with thrifty settlers the fertile basin where life without levees would be impossible, and it becomes incomprehensible how anyone can oppose the completion of the levee system, unless it be on the score of ignorance as to the facts in the case.

Contrast the peaceful condition of things where levee protection exists with the suffering and misery during a flood along the unleveed portions of the river, as revealed by a trip along the river during any flood, and no argument is needed to demonstrate the wisdom of a perfected levee system.

That occasional breaks should occur in levees, partially completed as to both height and section, is by no means surprising. They are to be expected, and they may occur under great stress on rare occasions even in a completed system. But the area flooded and the damage done on such occasions will be trivial as compared to that of the general flooding of the entire basins under the "no levee" system.

The argument that the floods should be permitted to fill the basins in order that the sediment might build them up, so as to reach ultimately a height above overflow, has no substantial facts to justify it. If it were practicable to deposit on the land all the sediment carried by the stream, it would still take a very great number of years to raise the general elevation of the 30,000 square miles of basins to any tangible extent. Then, too, the deposit could never reach the height of the rare, exceptional floods, and if the doctrine

is true that the bed of the river is rising, the relative height of bed, banks, and flood would remain the same, and overflows would always continue.

There can be no reasonable doubt as to the possibility of constructing an effective levee system. Far more elements of uncertainty are involved in many engineering problems that have been carried to successful completion.

The engineers of this progressive age will not falter in their conviction that the floods of even the mighty Mississippi can be effectually controlled, and it is not likely that a nation with such great resources as ours, which has undertaken to make the deserts blossom, will hesitate to contribute generously to a project which has for its object the conversion of the vast alluvial basins into fertile fields tilled by a prosperous people, happy and contented in homes of plenty.

ENGINEER OFFICE, U. S. ARMY,
St. Louis, Mo., February 12, 1904.

HON. JOS. E. RANDELL:

MY DEAR SIR: I have just received your letter of the 9th instant requesting my views regarding the much disputed question of levees and elevation of the river bed. In answer, I beg leave to state my conviction that the levees do not permanently raise the bed of the stream. It is, of course, obvious that, if waters, which at flood spread out under natural conditions over a width of 10 miles, are confined between levees separated by not more than 4 or 5 miles, there is bound to be an increase of flood height of the water, a fact which is becoming well known; but, at the same time, it must be remembered that this raising of the flood surface increases the velocity of the current and gives it greater scouring power and greater capacity to carry sediment. So it will be found that the total amount of sediment carried to the sea will not be less but rather more than if the floods could spread out over wide areas with more sluggish current. In fact, I believe that levees increase the flood heights, but actually decrease the low-water plane, or, in other words, depress the bed of the stream. The River Po, in Italy, is often quoted as an instance of levees raising the bed of the stream, and in actually crossing the Po, as I did in 1883, it seemed to me that the stream was really artificially elevated above the surrounding country, held in by its earthen walls, but the true condition was not what it seemed to be. The river was at flood, and, of course, the flood surface was far above where it would have been under natural conditions, but measurements made about that time, I am told, showed that the bottom of the stream was below its original level.

Hoping that my views are presented clearly, and that my reasons therefor may be understood by yourself and the committee, believe me,

Very sincerely yours,

THOMAS L. CASEY,

Major, Corps of Engineers, Member Mississippi River Commission.

MISSISSIPPI RIVER COMMISSION,,

Chicago, Ill., February 12, 1904.

HON. JOSEPH E. RANSELL,

House of Representatives, Washington, D. C.

DEAR SIR: I have to acknowledge the receipt of your favor of the 9th instant, in which you request me to state my views and my reasons for entertaining them upon the question, "Do levees cause the bed of the Mississippi to rise?"

Persons not familiar with the Mississippi may perhaps wonder why there should be any doubt upon this subject—why the facts should not be so well known that there can be no room for discussion. The explanation lies in the unstable character of the river bed. The bed is composed of an alternating succession of bars and pools, all in motion downstream. At one stage the bars build up and the pools scour; at another this process is reversed, and there is a leveling action. The river also has a motion sideways, due to erosion on one side and accretion on the other. Evidently any general law, such as the raising or lowering of the river bed, if there be such a law, can be detected only after prolonged observations and intelligent study.

The Mississippi River Commission has given much attention to these observations. In 1894, 1895, and 1896, a complete resurvey of the river where most completely leveed was made from the mouth of the White to Donaldsonville, La., a distance of 472 miles, and careful comparisons were made with the previous survey of 1881, 1882, and 1883. Nearly 3,000 cross-sections of the river, with about 150,000 elevations, were compared, involving an enormous amount of labor. The result was to show no evidence whatever of a rising of the bed.

On the other hand, the gauge records give some evidence that the bed has been lowered by the levees. A careful comparison of the low-water readings of ten gauges between Cairo, Ill., and Carrollton, La., was made by Major Harrod, for the periods 1872 to 1887, and 1887 to 1902, using the average for the sixteen years of each period. As a general rule, the low-water surface was at a lower level during the second period than during the first. That there

was no great difference in the quantity of water flowing is shown by the fact that the reading of the Cairo gauge was essentially the same during the two periods.

Theoretically, I should expect the levees to have a tendency to lower the bed in some small degree, but that the amount would be so small as to be of no practical importance. That they should have the effect of raising it, I can not conceive. The result of all the observations on the river so far is that there has been but little change, and that that little has been in the direction of lowering the bed.

Yours very respectfully,

O. H. ERNST,
*Colonel, Corps of Engineers,
President, Miss. River Com.*

124 EAST TWENTY-SEVENTH STREET,
New York City, February 15, 1904.

DEAR SIR: Your favor of the 12th is received. My opinion that levees have not caused a rise in the bed of the Mississippi is unchanged.

Very truly yours,

C. B. COMSTOCK.

MR. PATRICK HENRY,

Interstate Mississippi River Improvement.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
Washington, February 16, 1904.

MY DEAR MR. RANDELL: I beg to acknowledge the receipt of your kind letter of February 15 asking my opinion as to whether the construction of levees upon the Mississippi River has a tendency to elevate the bed of the river.

This subject was treated very exhaustively in 1890 by General Comstock, then president of the Mississippi River Commission. The particular subject of your inquiry is referred to in General Comstock's paper, and will be found on page 3098 of the Annual Report of the Mississippi River Commission, 1890. I concur in the opinion therein expressed, which I have held from the beginning of my familiarity with the Mississippi River.

I do not think it can be doubted that the effect of levees has been to increase flood heights; the result at your own home, Lake Providence, exemplifies this in a marked degree. It does not necessarily follow that there has been any elevation of the bed of the river at low stage. I do not believe that there has been, nor do I believe there has been a progressive and continuous elevation of the

bed for any long stretch of the river at any point in its course from Memphis through the levee district.

If you are not familiar with General Comstock's paper, I advise you to consult it, because he includes in his examination not only the Mississippi River, but the Po, Hoang-ho, and the Yellow River, the most prominent examples of sediment-bearing streams.

Very respectfully, your obedient servant,

G. S. GILLISPIE,

Major-General, General Staff.

HON. J. E. RANDELL,

House of Representatives.

APPENDIX F.

IMPROVEMENT OF THE MISSISSIPPI RIVER.

HEARING BEFORE COMMITTEE ON RIVERS AND HARBORS, HOUSE OF REPRESENTATIVES.

WASHINGTON, D. C., *Tuesday, February 2, 1904.*

The committee met at 10.30 o'clock a. m., Hon. Theodore E. Burton in the chair.

The CHAIRMAN. Mr. Parker, how much time is required by you?

Mr. PARKER. I should say that we have six speakers, and they will take not exceeding fifteen minutes apiece.

Mr. PATRICK HENRY. Mr. Chairman, there was a great levee convention held in New Orleans in October, which was attended by over 1,000 registered delegates from 166 cities and municipalities of this country, from 22 States. They passed a resolution which this delegation has been appointed to present to this committee, and I will introduce to you, Mr. Chairman, and to the committee, Mr. John M. Parker, the chairman of the committee, who is probably now the largest cotton commission merchant in the world, young as he is.

STATEMENT OF MR. JOHN M. PARKER.

Mr. PARKER. Mr. Chairman and gentlemen of the committee: In October of last year, in New Orleans, we had one of the largest non-political conventions ever held in the United States; to which were appointed over 3,000 delegates, representing every branch of industry in this country. Of this number we had probably a thousand who were actually present, representing over 166 of the largest cities of the United States and comprising 27 different States.

The proceedings of that convention have been communicated in detail to each and every member of the committee, so that any further details from me on that matter would be useless. Speaking from a business man's standpoint, I do not think there is any subject in the United States that is of greater importance than the rivers and harbors which are directly and closely affiliated with our levees down there.

Few gentlemen who have not been down there and seen our levees and the conditions behind them can appreciate the conditions and possibilities of that country. To-day you find that England and France and Russia are spending millions of dollars in order that they may be able to raise cotton in competition with the American product. There is probably no place on the face of the globe that naturally offers the facilities that Mississippi does. Twenty-five per cent of the land available there is now in cultivation, and with protection to that area down there we could probably put in 15,000,000 acres additional. That to-day is largely typical swamp land, representing the fertility and deposits of silt of centuries upon centuries. One of the great reasons now that every acre of that land is not put in cultivation is that, with the vagaries and changes in the Mississippi River, people are afraid to come there and put their money into it and develop it. That is one reason why this convention came together down there and appealed to the United States. That, Mr. Chairman, was one of the strong reasons why the people of that region appealed to the United States to come down and give them protection, either by taking absolute control of the country or making such appropriations as will enable us to continue the work that we have undertaken, and guaranteeing safety.

We are not unaware that this committee has done a great deal, and the highest tribute that can be paid to the efficiency of their aid and the ability of the men who have conducted that work is the statement that no levee that has ever been erected under the auspices of the United States Government has ever failed to serve its purpose and to continue to do so. There are strong reasons why that statement is a fact. Our old levees—many of them levees that have been built a little at a time and from time to time—whereas the Government levees have been erected by the United States engineers with plenty of means to see that the levees are thoroughly and solidly built and properly constructed and are properly protected after they are built.

We do not come here exactly in the line of being suppliants, because we have put up two dollars for every dollar that has been paid out by the United States Government for this purpose, but there are thousands of acres in that Delta that are not worth over \$2 an acre, which, if put into cultivation, as they certainly would be the moment that it was known that the United States Government was going to protect these levees, would rise in value to \$50 an acre. Many of those people own their lands, and are not men who are actuated in the slightest degree by personal interests. We occupy down there a unique position, inasmuch as we sell everything we raise. We furnish the largest exports to maintain the balance of trade of the world for the United States, and in return we buy nearly every dollar's worth that we use. We are the largest cus-

tomers for the farmers of Ohio and Tennessee and Kentucky for their stock; we keep the mills of Pittsburg running to furnish us with cotton ties and coal; we are the largest consumers of machinery in the Southern States; we buy everything that we use; and, over and beyond that, that river that flows by our doors has more importance and means more to the farmers of the West than anything else, because it furnishes parity of transportation rates and forces them to give us reasonable rates.

I do not know whether you have noticed the enormous strides that in recent years New Orleans has made commercially. This has been largely due to the fact that we had a few years ago no railroads at all through that Delta, and now we have five trunk lines—lines whose stocks and bonds are owned all over the United States. As a practical cotton planter, who has been in that business for twenty years, I would say that we think that this year the Mississippi Delta alone will make 16,000,000 bales of cotton. I think, sir, that with protection from the United States Government—simply the assurance of this committee that you gentlemen believe that the requests we make are fair, and you believe that you are better able to take charge of those levees than the separate States or than the separate levee boards which have under former methods of work undertaken it—I believe, if the commission of the United States Government makes the announcement to the world, the Delta will rapidly populate and be one of the most prosperous parts of the United States.

STATEMENT OF MR. M. F. SMITH.

MR. SMITH. Mr. Chairman and gentlemen, I will read the resolutions adopted by the Interstate Mississippi River Improvement and Levee Convention:

Resolutions adopted by the Interstate Mississippi River Improvement and Levee Convention held at New Orleans, La., October 27, 1903.

The committee on resolutions begs leave to submit the following report:

First. After years of actual observation and experience, and supported by the opinions of all engineers, whether from the Engineer Corps of the Army or from civil life, who have been directly connected with the work of levee construction, we desire to affirm that we have the most absolute confidence in the sufficiency of levees, when built according to correct standards, to protect the Mississippi Valley from overflow.

In support of this declaration we beg leave to submit the following facts, which have been fully established: An elaborate and careful investigation, made under the direction of the Mississippi River Commission, wholly disproves the notion, which still prevails to a considerable extent, that the immediate effect of levee con-

struction is to cause the bed of the Mississippi River to rise. If this were true it would necessarily follow that the levees would need to be continuously strengthened and elevated, and thus all hope of protection would have to be abandoned.

In the years 1881, 1882, and 1883 an elaborate survey was made of the river bed from Cairo to the Passes, a distance of 1,063 miles. Four cross sections to the mile were made, and 75 soundings were made to each line. The result of this survey was carefully plotted, recorded, and preserved.

In the years 1894, 1895, and 1896, after the lapse of a period of thirteen years, a still more elaborate survey was made of that part of the river bed between the Arkansas River and Donaldsville, La., a distance of 472 miles.

While local changes in the river bed are necessarily constantly happening by reason of the gradual movement downstream of the bends, and accompanying bars and pools, they of themselves signify nothing. Yet a comparison such as that which has been drawn from the result of the two extensive surveys mentioned would necessarily furnish proof that the bed of the river was rising if such were the truth. So far from the comparison indicating such result from levee construction, it was discovered that there is a general tendency to the establishment of a more uniform channel in depth and width and with greater capacity.

The comparison also brought to light the fact that the crests of the low-water bars, as well as those of the high-water bars, have been lowered.

If we turn to the evidence afforded by the records of the numerous gauges established along the river, which have also been carefully recorded and preserved, we find that the low waters now are several feet lower than they were in the years preceding active levee construction, accompanied by an equal volume of water and an equal depth of channel. This unquestionably shows that the effect of levee construction has been to bring about a gradual depression of the river bed. This effect has been produced within the past few years, for prior to that time there was no such restraint of the flood waters as could leave any impress whatever, one way or the other, upon the river bed.

The notion that the bed of the river is rising has been somewhat revived since the flood of 1903, because of the fact that at certain points the gauge reading showed not only unusually great elevation of the flood height, but irregular elevation. From this it has been deduced by some that at those places where the gauge readings were the highest there had been, as the result of levee construction, an unusual deposit of silt, thus raising the bed of the river. A simple explanation will destroy this theory:

In 1880, when the levees were by no means continuous and were

altogether insufficient to affect the flood plane in any degree, the first thoughtful and scientific observation of the river began. This was because of the fact that the Mississippi River Commission then entered upon the discharge of its duties. It was noted that the rise and fall of the river was very different at different points. It was observed that the greater annual oscillations, which were of about forty-five feet, were to be found at or near the mouths of the tributaries, such as the Ohio, the St. Francis, the Arkansas, and the Red rivers. It was also observed that the lesser annual oscillations, which were of about thirty-five feet, were to be found at intermediate points along the fronts of the great basins drained by these tributaries—as, for example, at Fulton, Memphis, Greenville, Lake Providence and St. Joseph.

A careful platting of the gauge readings at that time thus exhibited a smooth and regular high-water slope, but an exceedingly irregular low-water slope. This was caused by considerable depression of the river bed at or near the junction with the tributaries of the river, and a considerable elevation of the bed along the fronts of the great basins between them. For this reason it was noted that the rise in high water was much greater where the bed of the river was depressed at or near the points of junction with its tributaries.

It was observed that the discharge at high water at these points, because of these depressions, was something like 1,500,000 cubic feet per second, while along the intervening basin fronts the discharge was several hundred thousand feet less. This difference in discharge, ranging from a quarter to a half-million feet, was because of the escape of water over the river banks along these basin fronts. This escape of water undoubtedly caused the elevation of the bed along these fronts, which was noted, and we feel justified in affirming that when this escape shall have been permanently prevented by the construction of suitable levees, these elevated portions of the river bed will be gradually lowered to conform to the bed at the points of junction with tributaries, thus making a regular low-water slope. When this shall have been accomplished, undoubtedly the lowering of the river bed will go steadily on.

It has also been noted that during the flood of 1903 the heights attained by the flood in excess of those hitherto recorded were greatest at the points along these basin fronts, as, for instance, at Memphis, where the rise was 3 feet greater than any ever known.

The excess of flood height at the points of depression referred to was nothing like so extreme.

We therefore declare that, in our judgment, there is no warrant whatever for the assertion that the effect of levee construction has been or will be to raise the bed of the river, but, on the contrary, it is our definite conviction that the effect will be to cause a general and considerable lowering of the bed.

EFFICIENCY OF LEVEES.

Second. We also desire to express our firm opposition to all schemes for reducing flood heights of the lower river by the construction of reservoirs or so-called outlets. We refer to and indorse fully all that is said upon this subject by the very careful and able report submitted in 1898 by the Commerce Committee of the United States Senate, which is so complete and elaborate as to exhaust the consideration of the question. We will add that all schemes which have ever been proposed for the relief of the river in times of flood by outlets or reservoirs would either prove wholly inefficient or would cost such vast sums and require such constant care and expenditures as to entitle them to no consideration.

Third. While the flood of 1903 was very nearly as great as that of 1897, and while the flood plane was greatly in excess of that of 1897, the protection afforded in 1903 over that of 1897 is so great as to satisfy the minds of all impartial investigators that so far as the test has gone the principle of protection by levee construction has been amply vindicated. In 1903 there were but 6 crevasses as against 43 in 1897. With each recurring flood since levee construction began in earnest the number of crevasses has grown smaller and smaller, and the protection afforded has grown greater and greater. As a result, investments of capital in the Mississippi Valley have increased until they are almost fabulous. The low-lying back lands, which prior to that date were regarded as valueless, are fast being occupied and converted into homes for the benefit of our people. Towns and cities have sprung up in every direction. Railroads now traverse the valley so that nearly every part of it is now reached by them. All of this affords evidence of the strongest possible conviction on the part of the people that the time is sure to come when they will have absolute protection from the floods of the river.

Theorists may argue against the efficiency of levees, but they do so in vain. The strong common sense of the people responds by rejecting their theories. The work must go on. It can not now stop. Too much money has been invested in levees to suffer them to be destroyed, and unless they are prosecuted to completion they will be destroyed. The enormous investments made because of them, and in reliance upon their completion, can not in good faith be abandoned now to the devastation of the floods. We presume that no man can be found at this stage of the work to suggest that the plan of protection by levees should be abandoned, at least until a full and complete test has shown them to be impracticable.

MISSISSIPPI RIVER COMMISSION.

Fourth. The following abstract of the report of the Mississippi River Commission, just made, and hardly yet published, gives the

very latest opinion of the Commission upon the levee question, and is so comprehensive and pertinent that we give it at length, to wit:

"The past flood established, more clearly than has any previous one, both the importance, and the practicability of a complete and sufficient levee system. In its present condition, incomplete both as regards extension and dimensions, it gave substantial protection to three-quarters of the alluvial valley and its interests, which under equal flood conditions without levees would have been a lake from 20 to 80 miles wide from Cairo to the Gulf. The improvement made during the past six years has reduced the number of crevasses between Cairo and New Orleans from 38 to 6. Of the area overflowed this year, five-eighths was the direct result of back water from the lower ends of the basins and overflow through unbuilt parts of projected lines, and only three-eighths from breaks in the levees, notwithstanding their unfinished condition as regards both grade and section.

"Under these circumstances the importance of the earliest practicable completion of the work is apparent. If the flood damages of 1903 may be approximately estimated at \$5,000,000, the previous expenditure of that sum in permanent work would have largely if not entirely prevented them. Every year's delay in completion incurs the risk of similar loss. When the system shall have been completed the cost will have been increased by many millions of dollars, and the development of the valley delayed by many years of anxiety and disaster, which could have been saved by continuous work on a scale commensurate with the importance and magnitude of the improvement. The State levee districts realize this. Most of them have anticipated their revenues as far as practicable, and several have now under consideration plans for such increase of resources applicable to the work as will shorten the time of completion. The Commission is so impressed with this view of the subject that it considers it for the best interest of the work to now make contracts for levee construction to the extent of \$2,000,000, as provided for in the river and harbor act of June 30, 1905, and June 30, 1906. Furthermore, it suggests that if Congress should think proper to make additional provisions for levee construction during the fiscal years ending June 30, 1905, and June 30, 1906, the sum of \$2,000,000 in addition to the amounts already provided can be judiciously and advantageously expended during each year."

CONSERVATION OF COMMERCE.

Fifth. In addition to the protection of the lands of the Mississippi Valley from the floods, it is a matter of supreme importance that the mind of the nation should be kept constantly advised of the

commercial importance of the Mississippi River as a highway of commerce. The marvelous growth of railroad building within the last quarter of a century has so diverted the attention of the public from the Mississippi River as a means of transportation that it has been to some extent lost sight of. It has remained, however, a constant safeguard against undue rates of transportation and promises in the near future to become once more as active a factor in interstate commerce as it ever has been in the past. This is owing, first, to the almost unparalleled increase in industrial activity throughout the valley, and, second, to the demonstration which has been made in recent years that by means of hydraulic dredges a sufficient channel for low-water navigation can be secured and maintained. We earnestly express the hope that the work of the Mississippi River Commission in this direction be pressed as rapidly as can be properly done, with a view to opening up the great river once more, so that the people may fully enjoy the extraordinary facilities which it is capable of supplying for the cheap and steady exchange of their commodities. Levee construction is undoubtedly essential, even if all thought of reclaiming the fertile lands of the valley should be abandoned, for without levees all river commerce during periods of overflow would necessarily cease.

A GRIEVOUS BURDEN.

Sixth. The work of levee construction has been carried on by the cooperation of the United States Government through the agency of the Mississippi River Commission with the levee organizations of the several riparian States. Of the amount expended in this work, the Government has contributed, in round figures, about one-third. The people have subjected themselves to such heavy taxation in furnishing their contributions until they have already overburdened their resources in this regard. It is the opinion of the residents of the great valley that the difficulties and magnitude of the work and the vast benefits to result from it are such that in common justice the burden should be placed upon the strong shoulders of the Federal Government, and that the work should be urged to speedy completion. By suitable annual appropriations this can be accomplished, thus securing not only safety, but great economy. Therefore:

DUTY OF THE GOVERNMENT.

Resolved. That in the judgment of this convention the protection of the Mississippi Valley from floods is of such national importance as not only to justify but to make it the duty of the General Government to undertake it and press it to the speediest possible

completion. If, for any reason, the exercise of sole jurisdiction at this time by the General Government should not be deemed advisable then this convention urges most earnestly that Congress make, at its approaching session, such appropriations as are recommended by the Mississippi River Commission in its recent report.

THE COMPREHENSIVE PLAN.

Resolved further, That the system of river improvements in the Valley of the Mississippi from its headwaters to the Gulf and in the Valley of the Ohio and other tributaries, now provided for and those which may hereafter be provided for by Congress, under the supervision of the United States engineers, meets our hearty commendation and should be prosecuted to completion without unnecessary delay.

Resolved, That the attention of Congress is invited to the serious disasters which have befallen those residing at or near St. Louis, Kansas City, and other localities by reason of the recent great floods, and the Secretary of War is respectfully requested to cause an inquiry to be made with a view to the preparation of suitable plans for the prevention of a recurrence of such injuries.

Be it resolved, That the convention of delegates representing the States of the great Mississippi Valley from Duluth to the Gulf of Mexico gives its unqualified approval to the movement for the construction of a waterway connecting the Great Lakes at the north with the Mississippi River and the Gulf of Mexico at the south.

We recognize the expenditure of \$35,000,000 by the sanitary district of Chicago as a practical demonstration in the furtherance of this project. We express the hope that the Senators and Representatives in Congress from the various States represented in this convention will give their encouragement and assistance to Congressional legislation in favor of the completion of the deep waterway, to which the Mississippi Valley States has already given their approval, and to which the State of Illinois and the sanitary district of Chicago are committed as a matter of policy and by great financial expenditures already made.

Resolved, That it is the sense of this convention that the work of the Interstate Mississippi River Improvement and Levee Association, under the wise and able guidance of its president, Charles Scott, has been of great and lasting value, and its continuance is a matter of vital importance, and that this organization, as it exists, with Charles Scott as its president and J. W. Bryant and W. A. Everman as its secretaries, be continued, and that Charles Scott be authorized to appoint three members from each State as members of the executive committee of said association.

Mr. HENRY. You will next be addressed, Mr. Chairman, and gentlemen, by Mr. Charles S. Fairchild, of New York.

STATEMENT OF MR. CHARLES S. FAIRCHILD, OF NEW YORK.

Mr. FAIRCHILD. Mr. Chairman, in the last few years I have had occasion to go to the South and to New Orleans on business and pleasure a number of times. I have been in New Orleans at the time of this great convention in October, which is spoken of, and from all that I learned there, all that I heard, and from my own reflections, I have been profoundly impressed with the importance of this subject, and led to the belief that it was the supreme interest of the people of our whole country to take care that the best was done along the Mississippi River for the protection of its adjoining lands and for the improvement of its waterway that could be done under the teachings of science and experience.

This crop, this great cotton crop which they raise in that country, and the extension of which is possible beyond anything that we know now, is of vast importance to every part of this country. A failure of the cotton crop, or a permanent diminution of the amount produced, would make it necessary for the people of this country to readjust its whole financial relations with the world. It is, as the chairman of this committee which appears before you, Mr. Parker, has said, the thing that more than anything else maintains our balance of trade. It is the one crop in which the United States has practically the monopoly of the world. It is the one thing by extending which we can command the business of the world. We have rivals in everything else that we produce. In cotton our rivals are but few, and those poor and feeble. Therefore it behooves us to nurse and care for this unique thing which gives the United States so commanding a position in the world.

Then see all of our people who are more immediately interested in it. Think of the effect in every mill town in New England of the amount of the cotton crop; think of the effect, the possible effect, upon them now of a partial failure of cotton crops during the last few years; think of the thousands and thousands of people all over our northern country who are so immediately affected in their daily lives by this; and then, logically, with all else that we have done and are doing we should above all things promote the welfare of this Mississippi Valley. Think of what we have done in the past; think of the great sums of money for which the United States obligated itself to build railways across the continent; think of the vast empires of land which we gave away to build those railways; think of all that we are doing and proposing to do for irrigation in the great West, very properly and wisely, because it has been demonstrated that that must go beyond State lines. Think of all that we are doing to improve our harbors on our eastern coast. Why? Why, for the benefit of the wheat fields of the great West, the dairies of

our East and Middle West, in order that they may have a ready and easy access to the ocean.

Think of the great enterprise upon which we are entering in building a canal; to build a canal to connect the Atlantic and the Pacific. Think of what we are doing in the far East, in China, in extending our treaty relations, in taking up a position where we will have a greater influence and a greater access than ever before. Why? For what? To do what with them? To sell things to those people. What things? Why, the main thing we are to sell them is cotton—cotton goods. That is why we are willing to almost strain our relations with some of the nations of the world, that we may keep open markets. What we wish to sell in those markets is cotton goods. Now, if we do not take care of the production of the raw material of the cotton goods, all that we are doing in that respect is almost waste time, because we will cease to be a great cotton manufacturing country.

Now, all of these considerations lead me to the conclusion that logically, consistently with all that we are doing in these directions of which I have spoken, we should go on to do that which science and experience tells us will be most beneficent and most speedy for the extension of the production of this great staple. I am sure that there is no one in the North who, when he fairly considers the subject, when he considers the relations which it bears to all of our interests, when he considers the vast market which it affords for all of our Northern products in the South, giving a great interstate trade, when he considers the importance of it to our own interests, in connection not only with our own consumption, but with that of the world, will begrudge any expenditure this committee may consider it necessary to make to speedily and efficiently do that work that should be done along the Mississippi River. Further than that, by cheapening the means of transportation, by still further increasing this enormous commerce which now goes out from that Mississippi River, you will be conferring a benefit upon the remotest parts of our Middle West.

Therefore, gentlemen, it is with great pleasure and satisfaction that I have come here at the invitation of these gentlemen to say my few words and to urge you to do all that you possibly can to speedily complete this work, because every year that it is delayed is an enormous loss to the West.

Mr. PARKER. I will introduce to you next, Mr. Chairman, Mr. A. S. Caldwell, of Memphis.

STATEMENT OF MR. A. S. CALDWELL.

Mr. CALDWELL. Mr. Chairman and gentlemen, I want to say that I am not a public speaker and I want to save just as much of your time as possible because I know that it is valuable, and in order

to save hesitation and repetition I have made a written outline of the few things which I have to say to you, and I assure you that they are not very many.

In supporting the resolutions of the great convention which was recently held in New Orleans, I wish to give you the viewpoint of a business man, of one who, in 1882, left Indiana and cast his lot with the people of the great Mississippi Delta. While I live in the city of Memphis by separate business interests are in the delta itself.

This territory, which we are asking you now and which you know we have been asking you for many years to assist in protecting, has, I believe, about 19,000,000 acres of land; and I think there is less than one-third of that area that is in actual cultivation, and that third I know is very sparsely settled, and very poorly improved, because of frequent overflows. Now, in these times, when all the great nations of the world are striving after enlarged territorial possessions and hesitating at the expenditure of no amount of money in their purchase nor human lives in their conquest, is not this territory of itself, irrespective of the navigation of the Mississippi River, worthy of the attention of Congress, not only because of the increased population which will come and the increased commerce which Mr. Fairchild has so ably spoken to you about, and the increased wealth, but in order to maintain the supremacy of this country in the production of cotton?

Just now both Germany and England are giving a good deal of attention to the development of cotton fields in their colonies and in their various spheres of influence, and they are expending vast sums of money in this work. It is within the year that an agent of the German Government called upon me in the city of Memphis and told me that he had been representing for quite a long time the German Government in German East Africa in developing that country, and he wanted to pump me about cotton growing in the United States, and he wanted to get as much information as he could. He wanted to buy cotton seed and he wanted me to recommend to him white men who understood cotton culture and were open to employment by the German Government and who were willing to go way out there and open up that new country for cotton growing. Well, I told him all I knew, and I have no doubt that those fields as well as others will be greatly increased; although I believe with Mr. Fairchild that if the proper thing is done in this country we need never fear competition in cotton culture.

But the most important matter for the consideration of our people is the present condition of the cotton trade. On the basis of prices which have been obtained for that part of the present cotton crop which has been up to the present time marketed, and taking the present value of cotton as a basis for estimating that which is to be marketed from now until the end of the year, and taking the Gov-

ernment's estimate of the size of the crop, say 12,000,000 bales, as another basis, this present crop of cotton and seed will produce \$750,000,000. Now, not all of that will have been received by the Southern planters, but nearly all of it will have been received by Citizens of the United States. A little bit of it has gotten away to our friends of England, who bought cotton early. But not a great deal.

Now, it seems to me that a serious question, and one that I have not heard brought up before this committee, or in this convention, is the fact that all of the people of the United States who consume cotton—cotton goods—and that is practically nearly all of them, and especially the wage-earning class, the poorer classes of our country, have got to pay and have paid the enhanced prices of cotton by virtue of this short crop; and that may seem to you, without study, to be a small thing, but if you knew the advance in the price of cotton goods, based on the present value of the raw material, you could see that it is a very serious thing, and that many people at present prices will not be able to get as many cotton goods as they would under what I call normal conditions—that is, when cotton is about 8 or 9 cents a pound.

Now, gentlemen, would it not be infinitely better for us to get that \$750,000,000 out of a crop of 15,000,000 bales at 8 cents per pound—and that is about what 15,000,000 bales produces—rather than to get that large sum of money out of 10,000,000 bales of cotton at that very large price?

Is that not a matter absolutely of interest to every single person in the United States, irrespective of where he lives or what he does? But you must not stop at the contemplation of a crop of 15,000,000 bales, because the steady increase in the annual consumption of cotton makes it quite sure that it will be only a few years before 15,000,000 bales will be as short a crop in that day as 10,000,000 bales is to-day.

I think it is generally conceded that the consumption of cotton at moderate prices has now overtaken production, and that the largest cotton crop we ever raised, that of a few years ago, about 11,250,000 bales, would, if produced this next season, sell for at least 12 cents a pound; and if the conditions of the world remain normal, many people believe that an 11,250,000-bale crop would sell for more than 12 cents. So that in the last very few years—I think it is only three or four—what was the largest crop of cotton that was ever made, and which was talked about as a tremendous crop, has in that very short time down to the present time that I am talking to you, almost become a short crop. So that if we are to think about the material welfare of the citizens of this whole country, and what they are to pay for an article of clothing that probably they use more than any other article of clothing, we must

prepare in this country, unless we vountarily give it to other nations in the world, larger cotton crops.

Perhaps you may think that 18-cent cotton is the result of speculation. That is what I believe July cotton sold for yesterday, and by July cotton I do not mean speculative cotton, I mean cotton to be actually delivered in July from plantations or from interior points, wherever it may be now, to the particular market where that price was made. You may think that that high price of cotton is the result of speculation, but, gentlemen, you would be wrong. That is not the case. It is directly the result of too little cotton. As a business man who has had a great many years' experience with cotton and really ample opportunity to judge and observe, I should say it is the steady annual increase of consumption in the larger annual ratio than production. I can not help but be impressed with the gravity of the situation, and I do not believe that I am sounding a false alarm when I say I think it is well worthy of the attention of Congress and of this committee which has it so largely in its power to prevent the people of this country from carrying the present burden, and possibly relieve them of a heavier burden in the future.

To me the question does not seem to be one of soliciting you gentlemen for one million dollars or two million dollars or three million dollars this year or next year or the year after, nor does it occur to me at all as a question in which you should put the relative position of the great Mississippi River with the other rivers and harbors of the country. I know that there are other rivers and harbors just as much entitled to the support and help of the Government as the Mississippi River, but to my mind this is a great deal bigger problem than a river problem.

If Germany and England are willing to spend large sums of money in the development of cotton fields in their colonies, is it not worthy of your attention? And is there a surer way of bringing the price of cotton down to what it was a few years ago, down to a comparatively small price, than by the increase of the acreage planted in cotton? Some years the seasons may be favorable, or the negroes may work a little better that year, and we may arrange the acreage planted so as to make a somewhat larger crop than the year before. But larger cotton crops, as a rule, very much larger cotton crops, gentlemen, are only going to be obtained by increasing the area planted in cotton. I have no doubt that there are many places in the United States and in the Southern States, I should say, where there are still some lands available for cotton, but I know of no State that has a territory to compare with this great territory in the Delta of the Mississippi, none in which the area is anywhere near as large, and none where the land is anywhere near as fertile.

If this is worth doing, gentlemen, do you not think that it is worth doing just as soon as possible? As I am not here to urge your

appropriation of one or two million dollars for the next year, or any other sum, I am not here either to ask you to appropriate the whole \$15,000,000 that are necessary right now; but is it not worthy of carrying in your minds and making up your minds that it shall be done just as soon as possible, to be done in the most economical way, to be mapped out in advance as a continuous work, so that there shall be no waste of money by its not being able to go on after the thing is once begun?

There might be some reason for putting this off to the future, for putting off what you yourselves think were well done now, if we were poverty stricken; but, gentlemen, you know that that is not the case, for our present prosperity is the talk of all the peoples of the world, and it is actually the political slogan of more than one-half of the people of the United States.

Now, there is a little enterprise in which our Government was engaged a short time ago that has always struck me on my humorous side when it was brought up in connection with the expenditure of Government funds for such great public works as this, and that was the expenditure of considerably over \$300,000,000, I believe, and nearly 3,000 lives of our fellow-citizens, in wresting Cuba from Spain and presenting it as a free gift to people who are alien to us in blood and custom, and who love us just about the same as the average man loves a man to whom he is under financial obligations. There may have been some benefit to us, gentlemen, in having the Cubans rule Cuba rather than the Spaniards, but for my part it has not been at all clear. The sentimental part of that transaction was understood, and the taking from Spain was almost unanimously approved, but I am not quite sure that the present to these ungrateful Cubans would be as heartily approved just now. Cuba, with all its islands, embraces a territory of about 29,000,000 as against the 19,000,000 acres in the delta of the Mississippi, and a far larger proportion of Cuba's total acreage is and always will be totally unproductive.

Now, if the Government could afford to be so lavishly generous in making a present to these kind friends of ours in Cuba of so large an amount of money, gentlemen, is it asking very much, or is it a very strange thing, that we should ask the expenditure of a paltry \$15,000,000 to develop a Cuba lying in your very midst? Just think of this magnificent province. It is as large as Vermont, New Hampshire, Massachusetts, and Rhode Island. The undeveloped part of it is as large as Vermont, Massachusetts, and Rhode Island. That undeveloped part is of just about the size of New Jersey, Delaware, and Maryland. Now, suppose that those three last-named States were entirely undeveloped on account of overflows from the ocean, and that the \$15,000,000 would open them up to settlement, open up their lands to the various productive crops that those States can

raise; gentlemen, would there be any hesitation on the part of the United States Government about expending that amount to save and develop a province like New Jersey, Delaware, and Maryland? And yet we come to you and point out that here is a province a little farther toward the West, at present made unfit for population and cultivation, and for the production which I have suggested is to the benefit of the whole country, by overflows, not from the ocean whose waters can not be increased or diminished; an area which can not be increased or diminished as cultivated area is increased all over the country outside of this area I am speaking of, but a country which is affected by overflows of waters that pour down upon it from a little over two-fifths of all the other parts of the United States.

Now, I have heard it said in connection with these matters that the Mississippi River Commission, as it came down my way on more than one occasion, has said that God helps those who help themselves. If that is the case, gentlemen, certainly the nation, which is our earthly god, ought to stretch out a helping hand to this country down there, for they have been doing year after year everything in their power imposing upon themselves a burden, to keep from drowning in waters that come from the North, the East, and the West. You have been told about the difference between the amount expended by the Government in levees and by this country down there which is to be protected. I believe from the first levees constructed the Government has expended \$17,000,000, and the people of that country have expended something over \$40,000,000. Of course there was a time during this late unpleasantness when a good many of these levees were broken and destroyed; but even after the work was taken up again, after the civil war, the people down there spent a great deal more than the Government in that work. And it has been demonstrated to be effective.

I do not believe there is anyone on this committee, in view of all the reports of Government engineers and the Mississippi River Commission, who will doubt the efficacy of the levees, if they were completed, or the efficacy of the levee system even as far as it has gone; and if that is true, should not the Government down there, after the expenditure of \$15,000,000—even if all these other things do not make any impression upon you—put in the other \$15,000,000 to complete this work? If it is true that half begun is well done, I say that half done, if you are to stop there, certainly was not well begun.

Now, I am the owner of several plantations in that delta, and I have owned a good many. Before coming up here I had the tax receipts of the places that I now own, and some others that I owned only a few years ago, brought to me, and, gentlemen, the taxation down there varies from 2 per cent to 4 per cent on the cost of these

plantations to me, the variation being according to the levee district in which the plantation happens to be situated. Now, that is a taxation solely for levee purposes, not for anything else. It is solely for the purpose of maintaining the levees. Does not that suggest a pretty heavy burden of taxation? Does it not suggest that the people down there are doing all in their power to bring about a result which should be for the good of the whole country?

But you can not impose a heavier burden than that upon them. The property will not stand it. But if the levee system were completed, if it were entirely done, I have not any doubt, from the increased area in cultivation, and the increased value of the property, and the increased production, that the people of that country would be able to take care of and protect this levee system without any further assistance from the Government.

But the last thing I wish to speak to you about, and to my mind it is a very strong reason why the Government should do this work, and do it as quickly as possible, is this: We have with us in the delta a large number of the wards of the nation—the negroes. It is the natural home of the negro. There is the maximum yield of cotton for the minimum amount of work, and that always suits the negro. [Laughter.]

Among Southern negro farmers the drift has for many years been toward the delta, and still is, but interrupted by the frequent overflows. With the complete protection of this country, the negro will find his greatest opportunity, and he will not do harm to other States, because in those States the land will be taken up by the whites. The white man will not become a tiller of the soil in the South alongside of the negro, and as the negro gets out of the country the white settlers come in, and like the cultivators of the wheat and corn lands of the North they will become actual tillers of the soil. Now, I believe that in this very delta lies the solution of the so-called "negro question." We have him with us always, and he is on the minds of many of us. I have done a great deal of thinking about it, and I have tried an experiment.

I believed that the negro would become an industrious citizen and a fairly good citizen if he owned his farm; that not education but land ownership was the thing to elevate the negro, if you choose to call it that, but at any rate to better his condition and make him—what is to the interest of the whole country—a good citizen. I am not in the real-estate business, gentlemen, but I subdivided some of my own lands, and was instrumental in having some other land owned by some of my own friends subdivided into small farms, 40, 60, 80, and 160 acres, and these farms I sold to negroes without any cash payment, on long time and easy payments and at a rate of interest low in that section—6 per cent.

In nearly every instance I built a cabin, a little frame house, for

the negro to live in. In many instances I bought and furnished him a mule with which to make the crop, and in some instances I even went the length, after furnishing him the house and the mule, of furnishing him the money with which to live for the first year.. In all I disposed of a little over 23,000 acres in this way, and less than one-fourth of it has come back on my hands, and while in the instance of the other three-fourths the money has not all been paid, sufficient of it has been paid to guarantee that of those transactions the remaining three-fourths will turn out well. And in every instance the negro who has bought land has become a good citizen and an industrious citizen, and ambitious to further better his condition. And this has been my observation also of other negro land owners. I know that there are some exceptions; I do not mean to say that there are not; but I believe that the rule will hold generally good, and I have not the slightest hesitancy in telling you gentlemen that the negro farmer is a better citizen and a more successful man than the negro preacher, the negro doctor, the negro artisan, and the negro lawyer. I am not alone in this belief, for Judge Robert S. Taylor has said:

"In considerable and ever-increasing numbers they are buying land and becoming independent cultivators. Those who do so are steadily advancing in thrift, intelligence, and the qualities of good citizenship. Nowhere else in the South are as favorable opportunities offered to the black man as in the reclaimed Mississippi lowlands, and nowhere else is he doing as much for his own uplifting."

That is the observation of a man who does not live there, but who comes there a great deal.

I am sincere in bringing this negro question before you. It has not been done to make an additional argument, but it is done because I am fully convinced that there is a great deal in it, and that the opening up of that 13,000,000 or 14,000,000 acres of land in the Delta will do more than anything else to quiet a question that is not as loud in the South as it is in the North, but a question that is a serious one, the providing in some way for this great mass of black population that has got to do something.

Now, a great many people in the United States feel that the nation owes the negro something, and to them I would say, here is a practical way of paying that debt without giving him what the negro thought he ought to have at the end of the war—40 acres and a mule—and what he certainly is not going to get from Uncle Sam, and that is Government rations.

STATEMENT OF MR. LEROY PERCY.

Mr. PERCY. Mr. Chairman and gentlemen of the committee: My conception of the duty of this committee in coming here before you was to tell the Committee on Rivers and Harbors here the char-

acter of conventions that passed these resolutions, the diverse interests represented by them, and to vouch in person for the earnestness of purpose and the dire need which prompted the demands or requests upon the National Government.

I had not thought and do not think it advisable to attempt before this board of experts, as you may say, on this subject, to go into any academic or scientific discussion in regard to the Mississippi River, how the work shall be done, whether it can be done or not. At the same time, there are a few suggestions which appear to me to be pertinent, and if the committee will pardon me for the unprepared manner in which they are submitted, I would like to submit to the committee that there are three questions upon the affirmative answers to which depends whether this convention and its needs have any standing before this committee or any right to expect aid from the National Government. These questions are: Is this work of reclaiming the Delta from the overflow waters of the Mississippi River worth doing? Second, can this work be done? And third, by whom must this work be done if at all? Unless those questions can be answered in the affirmative, then, indeed, is our errand here a futile one. If answered in the affirmative, then the necessary aid must necessarily and will follow. The sole thing left for consideration is the time and the manner in which the work shall be done.

First, is the work of reclaiming this Delta one worth doing? Thirty thousand square miles of territory—alluvial land—is to be protected by the complete reveting of the Mississippi River. Twenty million acres of territory, of which there is possibly 6,000,000 acres in cultivation now. There are probably 4,000,000 acres that could not be put in cultivation, owing to the necessary overflow out and back water, no matter what system of levees you have; but there is at least 10,000,000 acres of it that is susceptible of the highest degree of cultivation. Upon this 10,000,000 acres of land, on the most conservative estimates, in addition to the diverse crops—sugar cane and corn and other agricultural products that can be grown—2,000,000 bales of cotton can and almost certainly will be grown.

Is the growing of it a matter of national importance? The answer to that question has already been made in the eloquent and broad-minded and patriotic speech of Mr. Fairchild. He has told what that means to this nation; he has told how by our cotton crop we have been elevated almost, you may say, to the most commanding position among the nations, and he has told you how we have prided open the strong boxes of every nation on the globe. The cotton crop constitutes 28 per cent of the exports of the United States, 41 per cent of the value of all agricultural exports. To attempt to improve upon what Mr. Fairchild has said would be indeed to attempt to paint the lily; but the answer is not only found in plain

English, such as he has spoken, but it is found in diverse tongues from all quarters of the globe.

The five greatest consumers of the cotton exported by the United States are England, Germany, France, Russia, and Belgium. They are to-day exhausting every effort, regardless of cost of the enterprise, going into the waste places of the earth, going among the barbarous uncivilized tribes of the world, in the effort to escape this tribute which he have inexorably demanded at their hands, and I hazard this statement, Mr. Chairman, that no civilized nation to-day is so depleted in treasure as to hesitate one moment to make an investment of the kind required here, \$20,000,000 at the outside, on an almost indefinitely small chance of realizing such a return as is promised here. Shall the United States, the richest and most progressive of all nations, flinch from such an investment when the return is not a venture but a certainty?

Mr. Caldwell has eloquently brought before you the fact that the cost of these cotton goods is one that affects every citizen of the United States. If this amount of cotton can be grown by means of this aid extended by the National Government or by reason of this work being done, then the question has been answered that the work is worthy of doing; that this income, which turns the balance of trade in our favor, which amounts to \$500,000,000 a year, and will increase from now on, is something worth struggling for; the investment is worth making.

Can it be done? Can the 1,140 miles of levee necessary to protect the Mississippi Delta be maintained? Is the project a possible one? About that in the past there has raised much discussion; about that in the future there can be no dispute and no question. The question has been answered with mathematical certainty that it can be done, and in dollars and cents you are told for what price it can be done. The Mississippi River Commission appointed in 1879 by the Government for the purpose of taking control of this river answers the question not by any apriori reasoning. Composed of some of the most eminent engineers in the United States, selected on account of their competency and attainments, they have not trusted simply to the voice of science, but after spending twenty years and more investigating the question they say that the result of the high water of 1903, with the disaster that it brought, brought also the assurance that the end was in sight; that the problem had been solved; that it could be definitely stated what it would cost to complete the work now under way.

That overflow was the greatest that we have on record. In the 1,140 miles of levee the river made six breaks, counting breaks above New Orleans such as overflowed any area of country at all. In the entire line of levees there were six crevasses. Altogether there were 2.4 miles of levee swept away by the flood, but more than

nine-tenths of the levee district remained protected, notwithstanding the size of the flood, and the crevasses that did occur, did not occur in the incipient stages of the high water, so that the argument oft made and oft repeated that it will never be possible to build levees strong enough to hold the floods because the water will rise and overflow the levees unless they give way, failed in this instance. If there had been no break, there would have been no appreciable increase in the height of the water, demonstrating that the levees as made were almost sufficient to carry off this water, and showing exactly what kind of levee was needed to guard against the recurring waters of the future.

When you look back to 1882, when the entire district of Louisiana, Arkansas, Mississippi, Tennessee, and Missouri would have been submerged by this water, the question is answered as to whether these levees are a success, when you find that with such a flood only one-tenth of the ground protected was overflowed; and the Commission says that by the expenditure of \$18,000,000 you can complete and protect this system so that there is an assurance of safety behind these earthen walls.

The work, then, can be done. The next question is, Who must do it? That work must be done by the National Government. It can be done in no other way; and it will be done by the National Government, and for these reasons. In the first place, we are leveeing a national stream. It has been described as the nation's great sewer, draining 41 per cent, exclusive of Louisiana, of the entire area of the United States, draining of States and parts of States 32 in number. It is the water that the nation has gathered up and hurls down upon the denizens of the lower valley. Even in common law, and more so in courts of equity, the rule is well recognized the world over that no man shall use his own to the hurt of another.

It is a maxim, Mr. Chairman, that will not be disregarded by a great nation in dealing with its own citizens. From the cleared forests of the West and the Northwest in all these States comes all this mighty avalanche of water, and upon these people, a mere fringe of humanity that stretches along between the river banks and the hills, has devolved the duty of battling with these waters. It is the nation's duty, and therefore the nation will respond to it; and that it has not done so sooner has been because that sense of duty has not been awakened in it. It is a national work, Mr. Chairman, because this same commission reports to the Government that appointed it that without a perfected system of levees the navigation of that stream can never be brought to any condition of perfection. This is a channel that the Government owns, and the tribunal in charge of it tells you that these crevasses and breaks and overflows create shoals up and down the river which interfere with navigation and must necessarily do so.

The question as to the raising of the bed of the river has been answered by the report of the Commission. The experiments made by them, conducted through a number of years, have removed that apprehension from the minds of all people who have followed their investigations; so that I say, Mr. Chairman, in the interests of commerce that the Government will do it, because the Government alone can do it. It is of a magnitude beyond the reach of any local organization or board.

That, Mr. Chairman, is perfectly demonstrable, and in this connection I submit to this committee that, as Mr. Caldwell has said, these people have helped themselves. Through the long years, for years without, and since 1882 with Government aid, these people have struggled with this problem as best they could, by taxation imposed in a hundred ways so as to make it tolerable, they have sought to protect themselves. They have spent since 1882 more than \$20,000,000 where the Government has spent \$17,000,000. They have spent since and prior to the time of the Government commencing to aid them, \$40,000,000. Is there any other class of citizens which comes before this committee appealing for Government aid, whether they come from the great cities, with their countless millions of wealth, or wherever they may come from, that can make the showing that these little bands of straggling agriculturalists, hampered by State lines, State laws, and State constitutions, can make?

We have borne the burden through the darkest hours of adversity, and it is not to escape that burden that we now have come before the committee, but we come here for the purpose of showing that the work is beyond our feeble efforts—beyond all we can do; and if the committee will excuse me for a moment for dwelling upon local matters, I can best illustrate that by giving you the outlook in the district where I live, not as singular at all, but as illustrative of the difficulty of doing anything by local organization. That district is known as the Yazoo delta from the Tennessee hills to Vicksburg, embracing 325 miles of levee, 200 miles of which are within the district where I reside, the lower Mississippi district. We had, up to 1882, spent \$10,000,000.

The flood of 1882 devastated the entire country. I remember well the convention which assembled for the purpose of deciding the question of whether any more money should be expended on levees, not that the levee question was a failure, but that it was recognized that the work was beyond our means to cope with. At that time we had two banks in that district where to-day we have thirty; we had two oil mills where to-day we have twenty-eight; we had not and never could have had, without levees, a single mile of railroad, where to-day we have one thousand.

And it was decided to go on, and we went on under a tax imposed, to give you some idea of how this money was raised, of 5

cents per acre on all land, 5 mills ad valorem on all property, real and personal, \$1 per bale on all cotton raised within the district; and through these taxes we collected in those days about \$250,000 a year, and with that increasing as the development made the amount of tax collected greater, and since 1882 assisted by the Government, we have advanced to the condition of being probably the most prosperous part of the Yazoo Delta. The entire country is threaded with railroads; about 50 per cent of the land in that portion of the delta is cleared up, and to-day, with that prosperity, and with the increased returns coming from taxation, we are perfectly aghast and helpless at the outlay that confronts us.

The last engineer's report, made by the engineer of our local board, not for the purpose of parading our ills before the world, but because it contains information addressed to the board for the information of the District, showed that by the caving of those banks we would have to spend in the next few years \$1,200,000 in building new levees, and \$2,000,000 in raising our levees above the last water, and the lowest most scant margin consistent with any degree of safety would take \$3,700,000; and all that we had with which to do this work was this revenue from taxation of \$350,000 a year, a large part of which is devoted to acquiring rights of way and keeping up the levees already constructed.

But we have not shrunk with the protection of the Government—with the aid that the Government has given us. We have not held back with the idea that our own efforts might be charged against us by the Government when it came to the consideration of the question of assisting us. In the legislature of Mississippi there is pending a measure by which we propose to tax ourselves for \$1,000,000 more in bonds in that single district, and yet with all that, Mr. Chairman, unless the Government should aid the district, we are as helpless to-day as when we built the first yard of levee, because \$3,200,00 in two years is a sum beyond any possibility of raising by any system of taxation that can be devised by man; and so it is throughout these other districts. The labor is one beyond the power of the local boards. It is one easily within the reach of the Government.

When we say expended, Mr. Chairman, \$12,000,000 in two districts, the amount of the expenditure must not be taken as a criterion of what it is necessary for the Government to expend in order to give us protection. That \$12,000,000 is money that has been expended year by year in dribblets, as it could be raised from the people by taxation, and a large part of the work done with that money has been swept away by floods within the year, and that work has had to be built over and over again where we had built before. That does not represent the amount of money that would have to be spent if as much as was needed was available all at once and it was spent

intelligently, so that the floods would not carry away one year what had been placed in position the year before—spent by the one spending having means to do it at the proper times, and to see that what was done was properly protected and that the work done was not imperiled.

That is the reason I say, Mr. Chairman, that the work will be done by the Government, and I say again that we do not come here, onerous as this tax is, to escape from our burden; we are not driven here, and these conventions are not called together, for the purpose of escaping this taxation. Few who attend the conventions bear the burden of that taxation. We have borne it in the past, and with the aid of the Government we are willing to bear it in the future, but what we want is to have the Government say, "We are willing to add that to your efforts which will give you safety;" to say to the capitalists of the world, "Behind these levees you can place your money, knowing that it is protected by the Government;" and we want to be able to hold out to the laborers of the world an invitation—for here in this part of the world there is a greater demand and return for their labor than at any other place on the top of the globe—and we want to be able to say to them, "Here you can labor and rest in safety, because this Government guarantees that this work will be maintained."

So, as I say, it is not to escape the burden that we have borne that we are here. And as to what should be given by the Government, that rests within the discretion of the committee and of the Congress. But there is this to be considered, that if it is well to do it, you want to do it now; you want to do it just as rapidly as the money can be expended. If you know that you are going to do this work, do it so that you know you are not going to have to spend dollar for dollar in repairing work that has been swept away. Every high water through which the work is postponed menaces your entire work. Millions of dollars that you have invested will be swept away by a single flood; and not only that, but the local boards are your partners, Mr. Chairman, in this labor. They have been your partners, contributing three dollars to your one, ever since you have gone into this, and they are willing to be your partners in the future. You do not want by your delay to hazard the bankruptcy of your partners.

The flood of 1893 cost over \$5,000,000 in loss of life and agricultural products. The flood of 1906, if the levees are not placed in condition, may make that loss of \$5,000,000 seem a paltry thing. You want to do that work so that your completed system is left to the districts to maintain, if you see fit to leave it to them, and not as it is now—a system which every engineer along the line of the Mississippi knows is simply dependent upon the caprice of the flood, and which may be swept away by the next spring's rain. You can

finish that, put it in its completed shape, for \$15,000,000. I mean to say that the Government can do it for that. If you give us under this appropriation \$1,000,000 a year for this 1,140 miles of levees, that is barely enough to maintain it if you had it completed. Give us \$4,000,000 for four years, and complete the work which you have entered upon.

It is no answer to this, Mr. Chairman, to say that there are meritorious demands from other sections. Test it. Is the work worth doing anywhere? Is it the duty of the Government to do it? Can anyone else but the Government do it? And where these questions are answered in the affirmative, then make the expenditure, and it is a wise expenditure and a good expenditure of the Government's money.

The CHAIRMAN. Let me ask you just two or three questions. What share of the total appropriations, of the expenditures for rivers and harbors, do you think should be given for the Mississippi River?

Mr. PERCY. I do not know that the matter should be decided in that way. The question is, What does the Mississippi River need? I could not answer that, as to what share of the total should be given to the Mississippi River.

The CHAIRMAN. We have the same argument from at least a hundred other sources all the time. They say the question is as to what they need. We have to equalize them.

Mr. PERCY. Then you have to look to the national character of the work, Mr. Chairman, and the magnitude of it, and see what is necessary.

Just one other thing: The most of the work that this committee is doing in the appropriations for various harbors and cities, all of which are wise and right, that work is frequently permanent. We might be satisfied with what you are giving us with the million dollars a year you are giving us, we might be willing to struggle on with this conflict at that rate, but you are imperiling every year your own investment. It is not like building a house, where you can stop if driven to it because of lack of funds, and later you can go back and find the house there as you left it.

The CHAIRMAN. The argument is very strong with regard to the levees, but it is not exceptional, for in many other cases the work has to be finished before it can be used, and it is liable to destruction if it is left.

Mr. PERCY. So it is, in some instances.

The CHAIRMAN. As, for instance, in the case of breakwaters. How many crevasses were there in this district?

Mr. PERCY. Only one.

The CHAIRMAN. What is the present condition of the levees to

resist ordinary floods? Suppose that we have only an ordinary flood in 1905?

Mr. PERCY. The ordinary high water we would be protected from by the existing levees. It is the high waters that come every three or four years, or four or five years, that do the damage.

The CHAIRMAN. Why must this levee be raised four or five feet?

Mr. PERCY. Because the high water in this district was in some places more than a foot higher than the levee for 4 miles. I saw the levee raised more than 1 foot with the water lapping over it with every wave. That was raised by sacks, mere temporary work, which was done at a cost at that particular place of about \$40,000. That work was purely temporary, and had to be put up to prevent the water running over the top of the levee and submerging the whole country. A raise of 2 feet simply puts about 12 inches over the last high water.

The CHAIRMAN. I believe the last flood was more severe than its predecessor, in 1897?

Mr. PERCY. Yes, sir.

The CHAIRMAN. And more severe than others?

Mr. PERCY. Yes, sir.

The CHAIRMAN. In how many places would you say that the levees were threatened in your own district?

Mr. PERCY. They were threatened along the entire 200 miles.

The CHAIRMAN. That is, the crevasses would be likely at any point?

Mr. PERCY. Yes, sir.

The CHAIRMAN. You think it difficult to select the weak places?

Mr. PERCY. Yes, sir; at some places there are only a few miles where we have been able to reach Government grade—that is, the grade that the Government engineers say would give safety. Those places are safe, but the works need raising and also enlargement.

The CHAIRMAN. What would you say with reference to the construction of levees. Are they threatened with undermining by the river?

Mr. PERCY. No, sir; not except where the river has caved up rapidly to within a short distance.

The CHAIRMAN. That is where revetment is needed?

Mr. PERCY. Yes, sir; the Longwood levee in our district, one of the largest in the district and one of the worst threatened points always in previous years, because of the poor foundation for it, and because of the exposed position to water wash, that levee was built up to grade and built up to the river bank. It has never been a source of anxiety since. But an examination within the last three months showed that it has caved up to within 300 feet of the face of that levee, and that it was still caving in at the rate of more than

half the distance in a year. That means that that levee has to be relocated within two years.

The Government engineers have made an estimate of the cost, and it appears that that levee has to be put back for two miles or more. The cost of the entire work, including any damages and effects of water, and so forth, is \$500,000. and nine miles of a trunk-line railroad will have to be removed—moved back, and the entire traffic on that road will have to be interrupted during that work.

The CHAIRMAN. If the levee system is to be completed, what will be the principal source of expenditure, for revetments to prevent caving, or for the construction of levees proper?

Mr. PERCY. The principal source of cost would be where it would become necessary to relocate a levee on the ground and the moving. Where you locate the levee back you are bound to take the chance of some extraordinary caving reaching it within the next ten years.

The CHAIRMAN. What would you say as to the general policy of the Government, as to what we should recommend in this committee, in regard to the protection of all lands abutting on rivers from flood or from the ocean? Now, I notice in the resolutions presented here that there is a recommendation as to St. Louis and Kansas City. What would you say as to the policy that we should pursue there?

Mr. PERCY. That is simply what the Government engineers should investigate and report if anything could be done by the Government to prevent the recurring floods there. What I should say was the proper way would be to handle these questions as they are presented to you and in order of magnitude and merit as these claims seem to warrant. You can not at one session of Congress, or you can not now, map out what will be the limits of the river and harbor expenditures, but you can say, "here is a work we have got to do," and you can say that here is a work that is worthy of care, and this is a work the magnitude of which is known.

The CHAIRMAN. Of course we do not blame you for your earnestness, but there are many other things which are presented to us with equal earnestness. How about the Mississippi River above Cairo?

Mr. PERCY. The people up there are much better able to present their claims to you than I am. (Laughter.)

The CHAIRMAN. How about the Missouri River. That is another question?

Mr. PERCY. Yes, sir; that is a matter that worries the Missouri man.

The CHAIRMAN. That, of course, is a very serious question for the committee, as to what should be the general policy in regard to it. I think it is only due to the committee and to you to say that we

have before us \$500,000,000 of estimates, and our bill does not carry more than \$25,000,000 a year. Now, doing the best we can to take care of the estimates, it is a difficult matter. Anything you do to stimulate and educate the public sentiment in these matters will help us, of course.

Mr. PERCY. There is one thing certain, you must get away from that limit of \$25,000,000.

Mr. FAIRCHILD. Mr. Chairman, as you have been talking, it has seemed to me that questions of this nature we make a great mistake in not treating as a whole; we make a mistake in treating them as merely annual affairs.

Now, you are going to build this canal, and you are going to issue bonds to provide for the whole enterprise. Here is a thing which is not like others that you have suggested, but which will last for all time in its importance. It is not like the question of keeping a harbor clear, of dredging the annual accretion of deposits in a harbor, but it is doing something such as the building of a canal, such as we are doing in the State of New York in making the barge canal through that State, which is for all time, as that is there.

Now, it seems to me that wise statesmanship would take that in view, and if need be, issue bonds—do that which does the work most effectively and economically and expeditiously. It seems to me that the time has come when these great questions, and particularly a question like this which is of such vast importance to us and of such a permanent nature, ought to be considered in some such way, and not made to fit into the annual revenue of the Government.

The CHAIRMAN. Then, do I understand you that you would advocate the issue of bonds for this purpose?

Mr. FAIRCHILD. I would.

The CHAIRMAN. For river and harbor improvements?

Mr. FAIRCHILD. I would, where they are of this permanent nature, like the building of a canal, like the doing of that sort of thing. I think that economy and wise finance would treat the subject in that way and provide for the funds as they can be wisely expended, irrespective of annual revenue. That is the way I would do it if I was an individual doing it, and if I was the United States and had these things on hand I would do it in that way.

Mr. BISHOP. I would like to ask one question. You have had a great deal of experience in public affairs. The committee is largely up against this proposition and must assume some policy in its own defense in reference to it. Setting aside the Mississippi River, to which the Government is already pledged in a measure, would you advocate the policy of the Government caring for the banks of a river to prevent the erosion of private property?

The CHAIRMAN. The banks of rivers?

Mr. BISHOP. Yes, sir; the banks of rivers.

The CHAIRMAN. That, of course, must apply to all property and all characters of projects.

Mr. FAIRCHILD. I think, as a rule, I should.

Mr. BISHOP. That is, without reference to navigation.

Mr. FAIRCHILD. Not in reference to navigation. Where it is a matter that you can see is of importance extending beyond the locality, where it affects the country as a whole in its interests in any way, I should say that the United States should take whatever they determined should be its share of that.

The CHAIRMAN. Now, is it not true that the protection of all lands is of interest to the country at large, that is, the protection of agricultural or other lands bordering upon rivers?

Mr. FAIRCHILD. That is quite true. Of course the thing has got to be treated in a practical, sensible way, but there are some cases where you would fear to say that the interests of the country as a whole was not enough in it; there are others that will be doubtful cases, and there are others where it is manifestly so.

The CHAIRMAN. That is a question of great importance to us, Mr. Fairchild, because if we undertake that protection of land against floods and erosions, almost immediately the amount which must be appropriated for that purpose will be well in excess of the annual amount we are now expending for all the affairs included in our rivers and harbors bill, and everything. And this is true, and this has been one strong argument used in favor of the appropriations for levees of the Mississippi River, that it is a fact that the abutting property has paid half and more than half of the expense of the improvements down there. In that way this matter has been distinguished from the rest. Originally the argument, of course, was that it was in the interest of navigation, and to an extent certainly very plausible arguments can be made that it benefits our navigation now.

Mr. FAIRCHILD. It does benefit navigation; there is no doubt about it, and on that ground alone it is, of course, very important. But it is a very much broader question than that. We would not hesitate to spend any amount of money in acquiring a property which we can acquire in this way if it was an original proposition somewhere of acquiring it some place in the world, and we would not hesitate to issue bonds for that purpose. Now, this thing is of a great deal more importance than your isthmian canal.

The CHAIRMAN. That has not been the general sentiment of Congress.

Mr. FAIRCHILD. It is, and justifies that sort of thing—treating it on a large scale, with bond issues if necessary, I say. If that sort of thing is to be done it should be done on the same principle on which you build your isthmian canal.

The CHAIRMAN. Here is another question relating to this. Some years ago we could not pass a bill in the House but what the Senate would put on amendments appropriating very large sums for purposes of irrigation. Now if we adopt the general principle that money should be appropriated where the value of the land will be increased, and arable areas extended, do we not adopt the other principle, that money must be expended for a great variety of subjects, not only making lands available by irrigation, but giving them protection against natural calamities? Do we not do that?

Mr. FAIRCHILD. Very likely.

The CHAIRMAN. Do we not logically come to that conclusion?

Mr. FAIRCHILD. Very likely. But I think we must remember that in many directions the United States Government has entered upon that sort of work. It has entered upon it and it is going to do it. There is no use closing our eyes to the fact that we are not going back to the way that we used to do things. The United States Government is going on to do this kind of thing. We might as well make up our minds to that, and that being the case I do not see why we should not proceed, in view of that state of things, and do it comprehensively and systematically and in the most economical and effective way. It may be that we started entirely on a wrong basis in doing these things by the National Government at all, but we are doing them and we are going on to do them.

The CHAIRMAN. There is one point, of course, in this connection, that is pertinent to the work of this committee. Strictly speaking, our work should be limited to these appropriations which have to do with navigation.

Mr. FAIRCHILD. Yes, I know.

The CHAIRMAN. The deepening and improvement of rivers would improve the harbors as well. This question is before us because at the beginning it was argued that these levees were for the sake of navigation. We have continued them, and they are carried on our bill, partly as a matter of custom.

Mr. FAIRCHILD. But after all, the Congress and the country has ratified your action. They know that a large amount of your expenditure has been outside, really beyond, the subject of navigation, and it has become an established thing, it seems to me, that this committee does take these larger interests into consideration.

The CHAIRMAN. I hardly know an exception outside of this. The tendency has been to restrict expenditures to matters pertaining to rivers and harbors. This is true, that we all recognize the magnitude of the problem down there, and that it has been the settled policy of the Government for twenty years to recognize the great importance of developing those plans. It has, however, seemed to us that the benefit to the abutting property was such that that property should carry its share of the burden.

Mr. FAIRCHILD. I think that is true.

The CHAIRMAN. Here are lands worth only \$2 or \$3 an acre that may be made worth \$50 or \$60 an acre.

Mr. FAIRCHILD. Yes.

The CHAIRMAN. Now, is it quite right that that land owned by private parties, not an acre of it by the Government, or transferred to the States, should be so increased in value at the exclusive cost of the National Government?

Mr. FAIRCHILD. No; of course, when you put it that way, that is not correct. That is not correct, but even that applies to all kinds of things that you do; that unearned increment which was Henry George's favorite runs everywhere. In some countries they do those things a little better than we do. For instance, I noticed the system of street opening in Birmingham, England. Here in New York, for instance, if we want to open a street we take just the amount of land necessary for the opening of that street, and we assess the adjoining owners for the benefits and the city pays a portion. In Birmingham they take a great deal more land than is actually necessary for the opening of the street, pay everybody for it when they take it, sell it on long leases—the land that is improved—and it does not cost the city or anybody anything. That is not our system, but everything we do gives that unearned increment to somebody—almost everything you are doing.

The CHAIRMAN. The question is this, does the general improvement of a river or a harbor confer any such benefit on the adjacent property as does this improvement by the construction of levees? Of course every bill we pass, every improvement of a harbor increases the value of the property.

Mr. FAIRCHILD. Of course.

The CHAIRMAN. For instance, take the harbor of your own city—New York Harbor; the appropriations for that harbor increase the value of the property in the city, but do they increase that value in any such percentage as does this improvement?

Mr. FAIRCHILD. Why, Mr. Chairman, I suppose if you did not keep continually improving and taking care of that harbor property in New York would become almost valueless; and where are you going to draw the line as to where it comes?

The CHAIRMAN. But is it not a question of the proposition in which it benefits the adjacent property? This benefits this land to the extent of increasing its value ten to twenty times over. Is the property in New York benefited, increased in value, ten to twenty times by what we do in the harbor?

Mr. FAIRCHILD. You mean, suppose we had a harbor all stopped up so that ships could not get up beyond Sandy Hook, and you should come and dig it out and make a way across to that city, what would be the effect on property?

The CHAIRMAN. Certainly; that is not similar to this question, because it is a comparatively small expense in proportion to the result of this thing, while this is a very much larger expense.

Mr. FAIRCHILD. No, that would be fully as large an expense in proportion to the result obtained then. But of course if you go into that question, I think you have got to revise your whole system and go into an ascertainment of exactly how much benefit is coming to the localities and how much of the expense they shall bear, and then you have laid out a task of investigation which has almost no end.

Now it would appear that those people down there have put a burden upon themselves of all that they can bear with their present resources. You go and add some millions of dollars to what you give to help them, and you improve resources down there very much, indeed.

Now, unless you can devise some system by which the United States is going to take possession of those lands, improve the river, and then sell the lands and get the profit of it, which would be a business thing to do, you have got to take the chances of some people making more than their share out of the improvement, just as it is everywhere else.

The CHAIRMAN. But is this the real point? I tried to make this clear before; is not the added value here altogether out of proportion to what it is in the ordinary river and harbor? Here it is a conceded fact that these lands are worth only three or four dollars an acre, and that they will come to have a value of ten or twenty times as great after the improvement of these levees. Suppose you take the improvement of the Ohio River, for which a considerable amount is sought. Does the money expended there increase the value of property along the river in any such proportion as here?

Mr. FAIRCHILD. No; probably not. But I do not think it is any argument against making the appropriation that this is a far greater benefit and will increase the national wealth a great deal more. When you come to think that there is no other way of doing it, that the present property has been taxed to the utmost extent that it can be, then to produce the other result this other money has got to come. If people are benefited by that in a greater degree in some localities than in others, owing to the conditions, I do not see that you can gauge it.

The CHAIRMAN. There still remains the fact that we must take those facts into consideration. It may not be different in kind, but we have to notice differences in degree.

Mr. FAIRCHILD. Well, I do not think that makes any difference as to the appropriation. If you can devise any way to get that back out of the future benefits, well and good; but if you can not, that is no reason why you should not devise some way by which this improvement could be made.

The CHAIRMAN. I think the committee is fully of the opinion that certain appropriations should be made.

Mr. CALDWELL. I think you have an entirely erroneous opinion of the land prices down there, Mr. Chairman. I can not conceive how anyone would make a statement here that the building of these levees would increase the value of these lands ten or twenty times over.

Now let me state the facts as they exist down there now. Cultivated land is worth so much per acre according to its location in relation to railroad or transportation facilities, in accordance with its freshness, and in accordance with its improvement. Unimproved lands, woodlands, are worth about so much per acre to-day, in accordance with their location with reference to transportation, density of population, natural lay of the land as to drainage and levee protection. Now there is a great deal of land down in that country, unimproved land, that by many people is considered fully protected, but the people who consider it so are not so farsighted, because with the system not completed we can not say that any of it is protected. But, granted, here is a tract of woodland that is considered fully protected.

Now, that tract of woodland, irrespective of the value of the timber thereon, which is an entirely different proposition—and we are taking it for agricultural purposes only—is worth \$5 an acre, whereas in some other portion of the Delta another tract of land not rendered valuable by timber, but in the minds of the people fully protected from overflow, is worth \$2 per acre. What gives value to those lands? They are not increased in value ten or twenty times by putting up levees and completing the levee system. They never have been. Lands which before the completing of the levee system were worth \$2 an acre never jumped up to \$20 or \$40 after the levees were built. But the lands become valuable as the timber is taken off, as ditches are made, as houses are put upon the lands, as the plow goes into the ground, and as people come there and live upon it. That is what makes that valuable, and not the mere fact of the building of the levees.

Now, for us to get the people there, to get the houses and the ditches there, to get the plow in the ground, we must have the levees, and I think you are making a great mistake if you think that the increase in value by this is anything like so great as that; and if I had been asked the question as to the increase in value of the property in the city of New York by river and harbor improvement as against these improvements in the Delta, I would have said that the increase in the Delta is but a drop in the bucket as compared to the increase in value of the lands of New York.

The CHAIRMAN. Of course that was more by way of illustration. I have been reading with a great deal of interest the pamphlets

giving an account of the proceedings in New Orleans, and this estimate that I have spoken of is made in these addresses and pamphlets. So it does not originate entirely with me.

Mr. CALDWELL. People do all the time confuse those two ideas, as to the productive area of land and the increased value per acre.

STATEMENT OF MR. CHARLES F. HUHLIEN.

Mr. HUHLIEN. Mr. Chairman and gentlemen of the committee, you can no doubt realize my embarrassment at being asked to speak after those who have preceded me. I might say that Kentucky has, as you all know, an immense mileage of navigable streams, both within and along its borders. It has a comparatively small levee district, and I will not attempt to refer to any phase of that question. But if you will pardon me, I would like to indulge in a little personal shop talk. I am a manufacturer at Louisville, and since the 1st of January it has been my duty to contract for many hundreds of tons of pig iron for our own business which we have bought in the Birmingham district. We have bought many hundred tons of bar iron from the Ohio and Indiana mills, and it is my intention in a day or two to return home by way of the Pittsburgh district and to contract there for several hundred thousand tons of steel for our business.

I take the liberty of referring to that simply because I believe that we are typical of many hundreds, if not thousands, of industries all over the country. That is the interest that the manufacturing industries of this country have in the trade of the great delta, because we, along with hundreds, if not thousands, of other manufacturers, find our market largely, if not entirely, in this great delta of the Mississippi. Those people, as has been stated, buy everything they consume, they manufacture nothing and will hardly manufacture anything, and they sell all that they produce as raw material to keep the mills of our country busy. We believe that this great delta which would be reclaimed by these proposed improvements is one of paramount importance to this country, if you please, and we believe that it is well established that these levees simply expedite the current of the Mississippi River thereby causing it to scour a deeper channel and more readily confine itself within its banks, and we believe as manufacturers that the transportation interests of the Mississippi River are facilitated by these levees.

We believe that the property all along the Mississippi Valley would be greater, the internal commerce of that whole section, the interstate commerce of the whole section, would be facilitated by these improvements; and as Kentuckians, and as patrons of the iron and steel interests and many other interests of the other parts of the country, we would be very glad if your committee would recognize what we believe to be the vastness of this great project. We

believe that the best is none too good for any part of this great country, and we believe that a project as great and meritorious as this is merits the most generous and most liberal consideration at your hands.

STATEMENT OF MR. ALEX. G. COCHRAN, REPRESENT- ING THE MISSOURI PACIFIC RAILWAY SYSTEM.

Mr. COCHRAN. Just before the holding of the levee convention at New Orleans, invitations were extended to many persons throughout the country to attend, and among others to Mr. Gould, president of that vast system of railroads known as the Gould system, and I will read to the committee the brief reply which he made:

"I regard your convention to be held in New Orleans on the 27th as a very important event for the entire Mississippi Valley and all the great and diversified interests therein, and I hope the views and plans for levee protection that will be formulated will be so desirable to all interests, and including those of your great city, that they will commend themselves to the public at large and to the Congress of the United States, where it is hoped liberal appropriations will be provided.

The railroad interests I am connected with have under way and partially completed a low-grade line from East St. Louis, Ill., to New Orleans, crossing the Mississippi River on a great bridge at Thebes, Ill. When this line is completed it will be a water-grade line, paralleling the Mississippi and opening up virgin forests upon its west bank, and in addition it will make accessible great areas of farming lands susceptible of a high degree of cultivation if made safe from inundation. We are also, at great expense, rebuilding the railroad between Little Rock, Ark., and Coffeyville, Kans., and are constructing a new low-grade line of railroad in the White River Valley to connect our Kansas City lines with the main line of the Iron Mountain road. All of this, with necessary expenditures for equipment and other railroad appurtenances will amount to from \$40,000,000 to \$50,000,000, and the work has been under way for two or three years with the belief on our part that this great investment, the bulk of which will be in the Mississippi Valley, will be protected from damage by floods and inundation. The completion of our plans hereinabove outlined will inure greatly to the benefit of the city of New Orleans and largely add to her maritime trade."

Mr. Gould very much regretted that imperative engagements in New York made it impossible for him to appear in person before the committee, and he has requested me to speak in his stead.

I am interested in this question from a railroad point of view, because I am a citizen of the great metropolis of the Mississippi Valley, St. Louis, and because seven or eight of the best years of

my professional life, prior to becoming connected with railroad enterprises, were spent with that great engineer of the Mississippi, Capt. James B. Eads, whose counsel I was up to the time of his death. The Mississippi River has, therefore, always been a most interesting problem to me, and its phenomena a matter of careful study and thought.

Now, of course, it is apparent to every gentleman of the committee that the question of railroad development in this vast alluvial delta is one dependent absolutely upon the proposition whether the lands through which the railroads are expected to run shall or shall not be protected from inundation. It is idle to suppose that great capitalists, who have at heart, of course, the interests of the country through which they run—as being identical with their own interests—will expend the vast sums of money necessary to construct and equip railroads through this valley, unless they have some assurance that, when completed, their investment will not be swept away and destroyed, or unless they can have some further assurance that it will not cost more than the total amount of revenue earned for replacement or repairs because of injuries done by the floods. I can speak not only for our system of roads, which amounts to between 15,000 and 16,000 miles, but I am sure that every other railroad system which has lines extending through this Mississippi Valley is deeply in sympathy with this movement to reclaim those lands and protect them by levees, so that railroad construction, which has been greatly impeded, or absolutely prevented, in the past, by reason of periodical overflows, may be completed and protected. Of course no argument is necessary before this committee that railroads are indispensable to the development of that vast territory. They will certainly be there if they can be protected from overflow. They will as certainly not be there if they can not be so protected, because it is idle to suppose that they will be constructed unless they can be guaranteed substantial protection from periodical inroads of the river which would ruin the property.

There are certain propositions in connection with this problem which I suppose we may consider as practically conceded. First, it has been settled by Congress that it is proper to make appropriations for levee improvement, irrespective of the consideration whether that improvement conduces to navigation of the river or not, and, as all the members of the committee are aware, there has been for some years past set apart from the appropriations for the Mississippi River Commission a certain amount per annum which has been devoted to the building up and strengthening of the levees. With that precedent approved by years of experience, it seems to be idle to go into a discussion—

The CHAIRMAN. We all concede that, Mr. Cochran. The million dollars a year is set aside, and it has been discussed frequently

on the floor of the House and also in this committee. However, we have usually coupled with that the statement that the localities gave as much or more than the General Government.

Mr. COCHRAN. Of course there can be no complaint as to what the localities have done, because the records show that these good people who live down in that valley have taxed themselves to the utmost, have borne burdens heroically and with patience, for the building up of this great line of fortifications to protect themselves against that great on-rushing enemy. We have, as boys, all read of the dragon that lived in the mountains and came down at stated intervals and demanded his victims, devouring the people who lived in the valleys below. My hair has stood on end many a time, as a boy, reading that tale. It makes me think of the great flood of the Mississippi. Those people do not produce it, and their country does not produce it; it is produced by thirty-two States above them, and it comes rushing down through this channel, and swells to a mighty flood which spreads abroad, carrying havoc everywhere.

The CHAIRMAN. It is not one dragon only which is raised up before us.

Mr. COCHRAN. Well, we will have to kill them one at a time, and we will begin with this Mississippi dragon. [Great laughter.]

Down comes this great flood, pouring away from ten States, and probably twenty-two others, and here are these people with this rich land, undeveloped as yet, capable of supporting many times the number of its present inhabitants, capable of producing the enormous crops of cotton of which Mr. Fairchild has so forcibly spoken (every word of what he said I cordially endorse, as well as every word that has been said on that same line by other speakers)—here are these people to be protected. Now, is that an ordinary case? Are you going to look at that as you would at the question of whether a portion of the bank of the Ohio River, upon which I used to live, for instance, shall be revetted? Are you going to look at it as you would at the question whether there shall be a wing dam thrown out here or there, or whether this or that work shall be done here and there, as is ordinarily done for the protection of banks on these streams tributary to the Mississippi? If so, you are going to take hold of this question from the view point of the low valley and not from the hilltop.

This is a question that must be viewed from the mountain top and not from the low ground of the valley. Here is a vast region which, without the protection of these levees, will be destroyed or rendered practically worthless without that protection. Not only so, but there is this justification which the committee has for regarding this improvement as materially different from others, in that the Government of the United States has already invested more than \$17,000,000 in this improvement, and it becomes essential for

the protection of this large amount of Government money already invested that more shall be put in to save it. Consider for a moment. Is not that a good answer to those who would say, "We are technically just as much entitled to protection as those who live at the mouth of the river?" You see, gentlemen, our Government has invested this enormous amount of money in these levees. True it is that in the same time we were expending this \$17,000,000 the people living along the banks of this river expended \$40,000,000, or rather, from the year 1882, when the appropriations commenced, the people expended \$28,000,000. Now, in view of the \$28,000,000 that these people have put in here in good faith, and in view of the \$17,500,000, say, that the Government has put in, we have a vast investment to be protected. We are facing a condition and not a theory, and for the protection of that investment we should complete this work.

Gentlemen of the committee, this is no small question. It is a question which you must look at from the broadest point of view, and I do verily believe, if the good people of the United States could read those well-considered arguments that were made before the great levee convention at New Orleans in October last, that there is hardly a man in the United States who would not vote aye, and stand up, if necessary, in favor of this proposition. It is a great, broad, expanded theme, that needs great, broad and expanded treatment. We are bound to look at it from the broadest and the highest standpoint. These people need our help; they must have it. There is no use in doling it out to them in small amounts of money year by year. They have reached the maximum of their results in the way of raising money by taxing themselves. Now we must meet the situation upon that basis. A small amount of money spent in the next two or three or four years may be of some benefit, but along comes one of these tremendous floods, like the flood of 1903, and in a few hours the work which has been done has been swept away by that mighty and almost resistless tide.

Now, there is the proposition that confronts you, gentlemen. I know the difficulties of this committee; I know how every part of the country is demanding help; I know that in a technical sense the Chairman is right when he says: "Why, so and so asks us for this and that. Now, on principle, are we not forced to divide it up and give a little here and a little there?" I say you are bound to do that to a degree, but conditions must control you in this matter. The investment that I have spoken of, the demonstrated willingness of all these people to put their hands in their pockets and to help along to the utmost of their resources, which you do not find in many cases, and the grand results to flow from this, must be considered. As to the improvement of any of these tributaries of the Mississippi, certainly in the upper regions where the farms are, and where there

are agricultural communities, there is no vast overflow, but more correctly speaking a washing of the banks, and no one will pretend to say that there are any such conditions there as prevail down at the mouth of the river.

Now, there is this further consideration which, if you will pardon me, I will advert to, because you, Mr. Chairman, have referred to it, and I think you touched fairly upon every point in your questions. Mr. Chairman, there is this further to be said, and that is that the building of the levees promotes navigation and is a part of the scheme for the improvement of navigation. When Captain Eads first undertook to improve the South Pass of the Mississippi by the jetties, the little steam launch in which he and some of his engineers went about grounded in less than six feet of water. Now the commerce of the world passes through there unimpeded, through a channel not less than 200 feet in width and 30 feet in depth. Captain Eads was always an advocate of and a believer in the levees as instrumentalities for the improvement of navigation, and one can see for himself, without much study of the technical questions, how manifestly this is true. The capacity of a sediment-bearing stream to carry the material with which those waters are charged is dependent upon two factors—one, the volume of water, and the other the velocity with which that water moves.

Now, if you will look at this map of the Mississippi River you will see what I mean. If you allow the Mississippi River to scatter over a vast area of country, you are decreasing its volume, and just in proportion as you decrease its volume you decrease the carrying power of the current, you increase the friction upon the bottom, and the result is that instead of this volume of water passing down and carrying its load of detritus to the Gulf, where it is distributed over a vast area of deep water, it drops this load and decreases its own velocity. If you take a glass of Mississippi River water, it is as dark as coffee. Set it aside for a time and you will find that there is an inch of detritus at the bottom of it, and the remainder of the water is clear. What does this mean? The movement of the water has been stopped, and with the stoppage of this movement you have stopped its ability to carry this sediment. Now, it is the same in this matter of the cutting. The Mississippi River Commission has reported against the plan of these cut-offs for the purpose of overflow to let out the surplus water of the river to the one side or the other, holding, first, that to do so would build up a bar, and gradually, by building up above the curves, would raise instead of lower the flood line of the river, and furthermore, the Mississippi River Commission, after careful investigation and due consideration, has reported to Congress that the levee system adopted and approved by it on lines satisfactory to it is a system in aid of the navigation of the river.

Certainly the foregoing may be legitimately said in favor of a system of levees as an aid to navigation, but if people say, "We want you to reclaim our land," and it should turn out to be a mere matter of reclamation of land, pure and simple, without any benefit whatever to the general plan of improving the river, there you at once see that the two matters differ materially. But whatever way you look at it, and from whatever point you view it, the more you study it the more you must be convinced that this is a great exigency which the committee should meet in a great and broad-minded way.

STATEMENT OF MR. O. M. KILLOUGH.

MR. KILLOUGH. Mr. Chairman and gentlemen, I shall detain you a very few moments. I have been allotted by the chairman of our delegation ten minutes in which to tell this committee all about the benefits that the great valley has derived from levees, and what the needs of the levees are. I might very readily in that time give you all phases of the canal question, or settle the tariff question or the free silver question, but I feel totally inadequate to settle this question in that length of time. So I shall confine myself to one suggestion.

I come from a levee district in my State, and I must state things from our own personal experience, for I have no varied experience. This district is one of the youngest in length of maintenance along the river; some 230 miles in length and 20 to 50 miles in width. Until the levee system was begun in 1893 that country was a howling wilderness. We had a Mississippi River 50 miles wide every year, nearly. That river deposited flotsam and jetsam of all descriptions that it gathered up in its onward rush to the sea, and that deposit consisted of human as well as other waste, and some other things detrimental to agricultural interests. We had a country infested with a migratory class of people, who for a number of years immediately after the war and down until within a recent time reflected no great credit upon the great State of Arkansas. We flattered ourselves, and always contended, and do yet, that we were not responsible for the presence of these gentlemen, but had them because the sheriff of the county they came from was a crippled man, or they were more fleet than he was, and escaped, because they do not grow on Arkansas soil, and we do not sprout that sort of people.

Now, we feel safe in the hands of the Mississippi River Commission. We feel that, if their plans are followed out and they are allowed full and free control, the levee interests will be in no bad hands. I have not seen this suggested, and I wish to make the suggestion, and it will be all that I have to say to the committee. The Commission, in allotting the \$2,000,000 a year that has been allotted

to the Mississippi River, proposed at the last meeting of the Commission that the sum of \$2,000,000 be allotted to the district at once, rather than to follow the agreement made at the prior meeting of the Commission.

The CHAIRMAN. Two million dollars for levees?

Mr. KILLOUGH. Yes, sir.

The CHAIRMAN. The ensuing year?

Mr. KILLOUGH. Yes, sir; instead of the \$1,000,000 for each year. That allotment of the Commission failed to meet the approval of the Secretary of War, and the money was denied to us. Immediately following a great overflow it is clearly apparent to those familiar with the levees and the river itself that a small sum of money is much more advantageous and can be handled to greater advantage to the people of the district than a considerable sum spread out over a length of time. You take your canal, and when you have dug a mile you can go away and leave it and go back with a surety of finding the hole there, and you can continue your canal; but when you build one mile of levee and do not follow that up or build it sufficiently strong, and you go away and leave it and come back, you will find a canal instead of a levee, and the last vestige of the levee is gone and it is usually a vast ditch. If we should have the \$2,000,000 allotted by the Commission, I should feel that our district, which is the worst district along the river, would be greatly benefited.

It has now a bonded debt of \$1,500,000. It is settling rapidly, and it is fertile land; and if we had that money, or, in other words, if the recommendation of the Mississippi River Commission were carried out, I should feel that our trip has not been in vain.

The CHAIRMAN. Mr. Parker, is there a pamphlet of the proceedings of your levee commission in New Orleans?

Mr. PARKER. Yes, sir; a copy was sent to every member of the committee.

The CHAIRMAN. I would like to have that.

Mr. PARKER. I will see that copies are sent you, Mr. Chairman. Before adjourning, Mr. Chairman, I desire to thank you, sir, and the entire committee, for our delegation, for the courtesy and consideration with which you have listened to us, and I earnestly hope that we can report results when we get back.

Thereupon the committee adjourned.

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